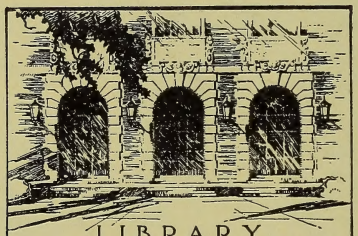

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THE GRADUATE SCHOOL

OF THE

UNIVERSITY OF ILLINOIS

ANNOUNCEMENT FOR

1909-1910

URBANA-CHAMPAIGN, ILLINOIS

Published by the University

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THE UNIVERSITY CALENDAR, 1909-10

As applicable to the Graduate School

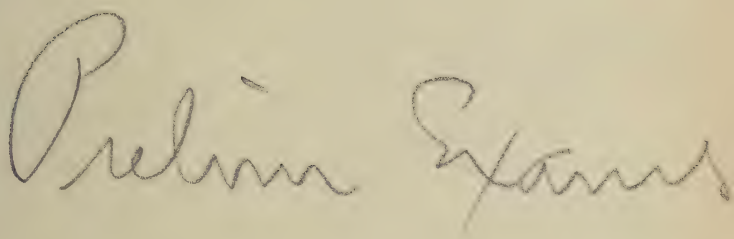
First Semester, 1909

Sept. 15, Wednesday, 8 a. m.	Entrance examinations begin
Sept. 20, 21, Monday and Tuesday	Registration days
Sept. 22, Wednesday, 8 a. m.	Instruction begins
Oct. 4, Monday, 4 p. m.	Senate meeting
Nov. 1, Monday	Latest day for formal announcement of thesis subjects for masters' degrees and for professional engineering degrees
Nov. 24, Wednesday, 5 p. m.	Thanksgiving recess begins
Nov. 29, Monday, 8 a. m.	Instruction resumed
Dec. 2, Thursday	Illinois Day
Dec. 6, Monday, 4 p. m.	Senate Meeting
Dec. 22, Wednesday, 5 p. m.	Christmas Holiday recess begins
Dec. 31, Friday, 5 p. m.	Latest date for submission of outlines of proposed theses by candidates for professional degrees in engineering
1910	
Jan. 3, Monday, 8 a. m.	Instruction resumed
Jan. 27, Thursday, 8 a. m.	Semester examinations begin
Feb. 3, Thursday, 5 p. m.	First semester ends

Second Semester, 1910

Feb. 7, Monday, 8 a. m.	Instruction resumed
Feb. 7, Monday, 4 p. m.	Senate meeting
Feb. 12, Saturday	Lincoln Day
March 8, Tuesday	Annual meeting of Board of Trustees
April 1, Friday, 5 p. m.	Latest date for filing completed theses by candidates for professional degrees in engineering
April 4, Monday, 4 p. m.	Senate meeting
April 7, Thursday, 5 p. m.	Easter recess begins

April 12, Tuesday, 8 a. m.	Instruction resumed
May 14, Saturday, noon	Latest date for receipt by Dean of doctors' theses
May 30, Monday	Military day
June 4, Friday, 8 a. m.	Semester examinations begin
June 5, Saturday, noon	Latest time for receipt by Dean of certified masters' theses
June 11, Friday, 4 p. m.	Semester examinations close
June 12, Sunday	Baccalaureate address
June 13, Monday	Class day
June 14, Tuesday	Alumni day
June 15, Wednesday	Thirty-ninth annual commencement



THE EXECUTIVE FACULTY

Of the Graduate School

Edmund Janes James, Ph. D., LL. D., President of the University

Thomas Jonathan Burrill, Ph. D., LL.D., *Vice-President, Professor of Botany.*

David Kinley, Ph.D., LL.D., *Dean of the Graduate School and Professor of Economics.*

Stephen Alfred Forbes, Ph. D., LL.D., *Director of the Illinois State Laboratory of Natural History and State Entomologist, Professor of Entomology.*

Albert Pruden Carman, A. M., Sc. D. *Professor of Physics.*

William Freeman Myrick Goss, D. Eng., *Dean of the College of Engineering, Director of the School of Railway Engineering and Administration.*

Guy Stanton Ford, Ph. D., *Professor of Modern European History.*

Chester Noyes Greenough, Ph. D., *Professor of English.*

George Abram Miller, Ph. D., *Professor of Mathematics.*

William Albert Noyes, Ph. D., *Professor of Chemistry and Director of the Chemical Laboratory.*

Julius Goebel, Ph. D., *Professor of Germanic Languages.*

Raymond Weeks, Ph. D., *Professor of Romance Languages.*

Louie Henrie Smith, Ph. D., *Assistant Professor of Plant Breeding, Assistant Chief of Plant Breeding in the Agricultural Experiment Station.*

HISTORY AND ORGANIZATION

Although the University of Illinois has for many years offered advanced students facilities for study and research in various lines, graduate work was undertaken under the name of the Graduate School for the first time in 1892. Beginning with that year each department offered such work as it could, without the organization of a separate Graduate School Faculty. In 1894 the administration of the school was vested in the Council of Administration and the Vice-President of the University became Dean of the School. As yet, however, the School had no executive faculty separate from the faculty of the undergraduate colleges.

In 1906 the Graduate School was organized as a separate faculty, consisting of a dean and members of the University faculty assigned to this duty by the President. No means of support, however, were provided, separate from those provided for undergraduate work. In the winter of 1906-7, the Forty-fifth General Assembly of the State passed an act appropriating $50,000 per year for the support of a Graduate School of the Arts and Sciences in the State University. This is the first time in history in which a State Legislature has made a specified appropriation for such a purpose and the act is noteworthy as committing a democratic government definitely to the promotion of advanced scholarship and research in lines which are not primarily "practical." The executive faculty was accordingly organized, and steps were taken to put such of the departments as were already prepared to do advanced work in suitable condition.

By act of the Trustees the faculty of the Graduate School includes all members of the University faculty who give instruction in courses approved for graduate credit. The affairs of the School, however, are in charge of the executive faculty, consisting of the dean and ten other members.

ADMISSION

Admission to the Graduate School is conditioned upon the presentation of credentials showing that the applicant holds a first degree either from the University of Illinois or from some other university or college of approved standing. Admission to particular graduate courses or departments may be secured only by those who have had the requisite undergraduate work in those courses or departments. If any student wishes to take graduate work in a department in which he has not had the necessary preliminary undergraduate training, he must secure this preparation in the undergraduate courses without credit toward an advanced degree.

In order to be enrolled as a member of the Graduate School a student must be doing graduate work. The possession of a first degree does not entitle a student to be enrolled in the Graduate School, if the courses which he is taking are undergraduate.

Students of mature age, who do not hold a first degree, but satisfy the dean of the school and the officers of the departments in which they wish to work of their earnestness of purpose and special fitness, may be permitted to take work in the Graduate School without reference to candidacy for a degree. In order to secure this permission, however, a candidate must have had such preliminary preparation for the work he wishes to take up as would justify his admission to the Graduate School as a candidate for a degree if he could meet the formal requirements fully.

Application blanks for admission may be secured from the Dean of the Graduate School or from the Registrar of the University, and these, properly filled out, should be filed with such documentary matter as the candidate can offer showing qualifications for membership, not later than the registration days in September.

REGISTRATION

Each graduate student must register when he first connects himself with the University, and afterwards at the beginning of each year. The first registration, however, or that upon entrance, is permitted only after the student's application for admission to the Graduate School, setting forth his educational attainments, has been duly approved.

After the application for admission has been approved the student receives from the Dean a permit to register and also a study

blank. This study blank must be filled out with the advice of the professor in charge of the selected work. The student must then pay his fees at the business office, secure a receipt therefor and return this receipt with the approved study blank to the Dean.

Each student is required to attend a minimum of four class, lecture, or laboratory, exercises, per week, in the first year of his graduate study; and in no case is he permitted during his course to attend more than twelve per week.

Residence.—Excepting as noted below, continuous residence and study are required of all members of the Graduate School, unless they are granted leave of absence by the Dean, upon recommendation of the professors in charge of their work, for the purpose of carrying on elsewhere studies or investigations in the line of work for their degrees.

Graduates of the University of Illinois, but no others, may be permitted to carry on graduate work for a second, or master's, degree in *absentia.* All such students must make out the usual application for admission, must submit their proposed courses of study to the Dean, whose approval, together with that of the professor in charge of the work, is necessary, before the student can be enrolled. Students who wish to pursue their graduate work *in absentia* are required to submit evidence that they have at their place of residence sufficient equipment in the way of libraries or apparatus to pursue the course of study proposed.

CHARACTER OF GRADUATE WORK

The work expected from graduate students is different in character from that usually demanded from undergraduates. Regularity of attendance, wide knowledge and ability to meet examination tests are of secondary importance. The principal aim of graduate study is the development of the power of independent work and the promotion of the spirit of research. Consequently, before he can get his degree, each graduate student is expected to show that he has acquired the power of independent research. In addition, each candidate is expected to have a wide knowledge of his subject and of related fields of work. For the graduate student is not expected to get from lecture and laboratory courses all reknowledge and training necessary to meet the requirements for his degree. The class, lecture, or laboratory, course is intended to

present the principles or theory of the subject and serve as a model or guide to the student in his private reading and research.

Students are warned against restricting themselves merely to the courses prescribed or suggested by the departments in which they are studying. Each student is expected to do a wide range of private reading and study; and in many cases will find it advisable to take one or more courses of lectures quite outside the field of his chosen subjects.

THE MASTERS' DEGREES

Candidates for the degree of Master of Arts or Master of Science are required to do one year's work in residence and to write a thesis.

The mention of one year as the required residence period does not imply, however, that a degree will be obtained in one year. If the candidate is inadequately prepared, or if his time and strength are impaired during the first year of residence by other matters, he will be required to spend a longer time.

While the work of a candidate for a master's degree consists largely in the broadening of his knowledge of his subjects of study, and not, to so great an extent, at any rate, as in the case of the candidate for the doctorate, in the development of the power of original research; nevertheless, the work of the candidate must be of a high order and must be such as to satisfy the faculty that he has done more that merely acquire a certain amount of knowledge by rote.

Each candidate for a master's degree may do all his work in one subject, or he may select a major and one minor, or a major and two minors. A major or minor, therefore, denotes the field of knowledge of a department, or such part thereof as constitutes a separate and independent field of study. However, the candidate must do at least half his work on his major subject. Each candidate for a master's degree is also required to present a thesis on some subject approved by the professor in charge of his major work, and the Dean of the School. The requirement of a thesis may be waived, however, upon the recommendation of the head of the department in which the student is doing his major work, and the approval of the Dean. Permission to take the degree without a thesis must be obtained not later than the "latest date for the approval of thesis subjects," as shown by the calendar.

Graduates of this University are permitted to secure their degrees on doing one year's full work *in absentia,* but this work must be spread over at least three years from the time of registration. Work *in absentia* is not permitted unless the student satisfies the Dean and the professors in charge of his work that he has the facilities to do it properly.

Candidates who are working for a master's degree *in absentia,* without a thesis, must present themselves at the University for examination not later than the first Monday of June of the year in which they wish their degree.

The completed theses of non-resident candidates for degrees must be filed by April first.

The Masters' Degree in Engineering

Two classes of second degrees are open to graduates of the College of Engineering, namely, academic and professional.

The *academic* second degree in engineering is Master of Science, following Bachelor of Science, in Architecture, Architectural Engineering, Civil Engineering, Electrical Engineering, etc. This degree is conferred in accordance with the regulations described above *for work in residence only.*

The *professional* second degrees in engineering are as follows:

Master of Architecture after B. S. in Architecture.

Architectural Engineer after B. S. in Architecural Engineering.

Civil Engineering after B. S. in Civil Engineering or B. S. in Municipal and Sanitary Engineering.

Electrical Engineering after B. S. in Electrical Engineering.

Mechanical Engineer after B. S. in Mechanical Engineering.

Civil Engineer, Electrical Engineer or Mechanical Engineer, after B. S. in Railway Engineering, according to the course.

Professional degrees are conferred upon two classes of candidates: 1. Graduates of the College of Engineering of the University of Illinois who have been engaged in acceptable professional work away from the University for a period of not less that three years after receiving the degree of Bachelor of Science. 2. Graduates of the University of Illinois, or of institutions of equal standing, who have been engaged in acceptable professional work in residence at the University for a period of not less than three years after receiving the degree of Bachelor of Science.

In "acceptable professional work" may be included contribu-

tions to technical literature, activity in professional societies, investigations of engineering problems, and the teaching of engineering subjects.

A candidate must declare his candidacy and file with the Dean of the College of Engineering as chairman of the Committee in charge a detailed statement covering his professional study and experience not later than the first Monday in November preceding the Commencement at which he purposes to qualify. Prior to December 31 next succeeding, he must submit for approval an outline of his proposed thesis, and he must file his completed thesis not later than April 1. If the statement of professional experience and study and the thesis are acceptable, the candidate must present himself at the Commencement exercises, and the degree will be conferred.

Candidates for professional engineering degrees, who already hold the degree of Master of Science, may qualify for the professional degree after two years of professional work, other conditions being the same as those prescribed for candidates holding the degree of Bachelor of Science.

THE DEGREE OF DOCTOR OF PHILOSOPHY

General Statement of Requirements.—The requirements for the degree of Doctor of Philosophy are a thorough mastery of a selected field of study, evidence of the power of independent investigation in this field, a broad knowledge of the wider field of study of which this major subject is a part, a general acquaintance with related fields of knowledge and a mastery of all branches of study which are necessary to a full knowledge of the main subject. Each student who is seeking this degree is expected to choose for study and final examination a major subject, or field of study, and a first and second minor. The major subject is the field in which the student expects to become expert and an authority. The first minor must be a subject closely related to the major and may, under certain conditions and with proper approval, be a sub-division of the major field of study. The second minor should be chosen outside of the major field of study.

When a candidate chooses any subject as his major and a division of that subject as his first minor, he is not permitted to choose as a second minor any division of work in that same department, excepting by vote of the executive faculty of the School.

The candidate's list of subjects must receive the approval of the head of the department in which he chooses his major work and of the Dean of the School.

Period of Study.—The minimum period of study required for securing the degree of Doctor of Philosophy is three years, and if a candidate of ability enters the Graduate School fully qualified to take up immediately the work leading to a doctorate and devotes all his time to the pursuit of his purpose, he will usually succeed in getting his degree at the end of three years. If, however, he begins his work without full preparation, or his strength is divided, he will be required to spend a longer time. In any case, the degree is conferred not for residence during a certain period, but for scholarly attainments and power of investigation, as proved by thesis and examination.

Candidates should note that "credit" is not given for work done in other universities, excepting in the sense that their residence at other institutions is counted towards the residence requirement for the doctor's degree. The candidate is examined here on the subjects offered by him for the advanced degree.

At least the first two or the last one of the three years required must be spent at this University.

Examinations.—Towards the end of his second year of study, or early in his third year, the candidate for the degree must submit to a preliminary examination conducted by the members of the faculty with whom he is doing his principal work, in order to determine whether he will be accepted as a candidate for the degree in the following year. This examination is partly oral, and may be wholly so. At this time, or before, the candidate will be required to demonstrate his ability to read French and German, and any other language needed for the prosecution of his work. Excepting where the chosen field of study itself includes the languages, the examinations in language are conducted so as to determine whether the student is able to use the language as a tool for the purpose of investigation.

On or before the last Monday in May of the year in which the candidate expects to come up for his degree, he must submit to a final examination by a committee appointed by the Dean of the Graduate School. This examination will be partly written. The candidate will also have, however, an oral examination. These examinations will not be confined to the courses which the can-

didate has attended in the University of Illinois only, if he has done part of the work elsewhere; nor even to the field covered by the courses specificially taken in this or other universities; but will be so conducted as to determine whether the candidate has a satisfactory grasp of his major subject as a whole, and a general acquaintance with the broad fields of knowledge represented by his course of study.

Before the candidate is admitted to the final examination and the defense of his thesis, he may be required to take any other examination, oral or written, that is thought proper by the various departments in which he has studied. If after having been admitted as a candidate for the degree, he fails in the third year of his study to meet the expectations of the professors in charge of his work, or in any way fails to maintain the standard of scholarship and power of research expected of him, he may be refused admission to the final examination.

The final examination in the major and minor subjects may not be divided. The examination must be taken all at one time even though it requires several sessions.

Thesis.—The power of independent research must be shown by the production of a thesis on some topic connected with the major subject of study. The thesis must be the result of the author's own investigation. No display of scholarship or acquaintance with the literature of the subject will secure the acceptance of the thesis if it does not show real power of research. The candidate is expected to defend his thesis or dissertation before the members of the faculty, or as many of them as may wish to question him about it, at a meeting called for the purpose, in the spring of the year in which he expects to take his degree.

The subject of the thesis should be chosen not later than the end of the second year of study and must be submitted for formal approval not later than the first Monday of November of the year when the degree is expected. A typewritten copy of the completed thesis must be in the hands of the Dean not later than noon of May fourteenth.

The thesis must be printed and one hundred copies deposited in the library of the University before the degree is conferred.

If, for any reason, the thesis can not be printed and one hundred copies deposited before Commencement time, the candidate must, before the first Monday in June, deposit a bond acceptable

to the Comptroller of the University and the Dean of the Graduate School for the cost of printing his thesis, or such part thereof as may be regarded as sufficient to meet the requirements of the rules.

The title page of each thesis must bear the words "Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in—(here put the major subject), in the Graduate School of the University of Illinois." The title page must also contain the full name of the author, the full title of the thesis, the year of imprint, and, if a reprint, the title, volume and statement of the pagination of the volume from which it is reprinted. Each thesis must have an appendix giving a short educational history of the candidate, including the institutions he has attended, his degrees and honors, the titles of his publications, and such other matters as may be pertinent.

SCHOLARSHIPS AND FELLOWSHIPS

A number of fellowships and scholarships has been established by the Trustees of the University. To first year graduate students of ability and promise there is open a number of scholarships with a stipend of $250 each and freedom from tuition, incidental and laboratory fees. To second and third year graduate students, that is, those who have had one or two years of graduate study, are open fellowships with a stipend varying from $300 to $500, with freedom from fees. The larger stipends are given only to students who are expected to take their degrees within the year. Each holder of a fellowship must pay the matriculation fee of ten dollars, unless he holds a first degree from the University of Illinois, and also the diploma fee of five dollars on receiving his diploma.

Candidates for these scholarships and fellowships must be graduates of the University of Illinois, or of colleges or universities having equivalent requirements for bachelors' degrees.

Applications must be made upon blanks provided for the purpose, to be obtained from the Dean of the Graduate School. These application forms should be addressed to the Dean of the Graduate School as early as possible in February of the academic year preceding that for which the fellowship is desired.

Applications for scholarships and fellowships should be accompanied with full information concerning the applicant, and

with any written or printed essays or results of investigation which he can submit.

Applicants for fellowships are required to agree to send the Dean of the Graduate School promptly notice of their acceptance or refusal; and to agree further, that, if accepted, the fellowship will not be resigned to take a fellowship in any other institution during the year for which it is awarded.

Nominations to fellowships are made upon the grounds of worthiness of character, scholastic attainments, and promise of success in the principal line of study or research to which the candidate proposes to devote himself.

Scholars and fellows are members of the Graduate School and have all the privileges and bear all the responsibilities of such membership.

Scholarships and fellowships are good for one year but may be renewed for a second or a third year in special cases. An appointment as honorary fellow, without stipend, may be made as specified for paid fellowships in the case of any one who has shown distinguished merit in his work.

Research Fellowships in the Engineering Experiment Station

The Engineering Experiment Station, devoted entirely to research, was established by action of the Board of Trustees, December 8, 1903. Its purposes are the stimulation and elevation of engineering education, and the study of problems of special importance to professional engineers and to the manufacturing, railway, mining, and industrial interests of the state and the country.

Ten fellowships, each of five hundred dollars a year, have been established in the Engineering Experiment Station. Applicants to whom these fellowships are awarded are required to agree to hold them for two years, devoting a part of their time to work in the Engineering Experiment Station of the University. Application for these should be made to the Director of the Engineering Experiment Station.

LIBRARIES

The general University library, the library of the State Laboratory of Natural History, that of the Agricultural Experi-

ment Station, and that of the College of Law are all at the University in Urbana. The libraries of the College of Medicine and the School of Pharmacy are in Chicago.

The general University library contains 130,000 volumes and 15,000 pamphlets. The University has a subscription list of 1,250 periodicals. The library of the State Laboratory of Natural History contains 6,100 volumes and 16,440 pamphlets. The library of the College of Law contains the Federal and State Reports, the leading textbooks, and a line of leading periodicals. The department of education has made a special collection of about 1,500 books and 3,000 pamphlets, which are kept in the rooms of the department in University Hall. This collection contains a very good assortment of modern text books, and copies of the courses of study of nearly all the large city school systems.

The general library of the University is open daily, from 8 a. m. until 10 p. m. and on Sunday from 2 p. m. to 6 p. m.

The Mason Historical Library.—The valuable library of western history collected by Edward G. Mason, Esq., long president of the Chicago Historical society, is in the Public Library of the city of Champaign, and is accessible to University students.

The Dittenberger Classical Library.—The University has recently acquired the library of Wilhelm Dittenberger, Professor of Classical Philology in the University of Halle. This library is especially valuable for the literary study of the classical languages, containing, in the best editions, the works of the poets and prose-writers, both Greek and Latin, and numerous works on grammar and history of literature, with between four and five thousand dissertations and programs on special topics. In addition there are many works dealing with the other departments of classical philology, as epigraphy, history of ancient peoples, archaeology, philosophy, history of art, geography, chronology, metric, etc.

The Heyne Library of Germanics.—The entire library of Professor Moritz Heyne of the University of Göttingen was bought in 1909. It contains about 5200 volumnes. The collection is rich in the general field of German philology and especially in lexicography. It has many rare first editions of works of German literature from the sixteenth, seventeenth and eighteenth centuries, and has sets of a number of rare periodicals. It is also rich in works upon the history of German civilization.

Other special library facilities of various departments are mentioned in connection with these departments.

FEES AND EXPENSES

Graduate students, not scholars, fellows or members of the corps of instruction, pay fees as follows:

Matriculation fee	$10.00
Diploma fee	5.00
Incidental fee, each semester	12.00

All graduate students who have not matriculated as undergraduates at the University of Illinois pay the matriculation fee on entrance.

All graduate students pay the diploma fee on being recommended for their degrees.

No tuition charge is made to scholars, fellows, assistants, or instructors, for graduate courses; nor for undergraduate courses on their study lists if approved by the heads of the departments and by the Dean of the School as necessary or desirable for the proper completion of the work for the degree. Otherwise, graduate students who take undergraduate courses must pay the proper undergraduate fee.

Each student working in laboratories, or in the drafting or engineering classes, is required to make a deposit of from 50 cents to $10.00, to pay for chemicals and apparatus used, and for any breakages or damages. But no charges or deposits for laboratory materials are required from scholars, fellows, or from members of the corps of instduction.

Table board may be obtained at prices ranging from $4.00 per week.

Room rent, with two in a room, ranges from $2.50 per week, per person.

DEPARTMENTS OF INSTRUCTION

Courses are offered in the following groups of subjects:

A. Languages and Literatures.
B. History and the Social Sciences.
C. Philosophy, Psychology, and Education.
D. Mathematics and the Physical Sciences.
E. The Biological Sciences.
F. Engineering.
G. Agriculture.

A. Languages and Literatures

ENGLISH

The Degree of Master of Arts in English.—In addition to complying with the general rules of the Graduate School (see pp — — —), candidates for the degree of Master of Arts in English must comply with the following rules of the department of English:

Candidates must take, in addition to the courses required for the first degree, a certain number of courses "for graduates"; (2) must include an elementary course in Anglo-Saxon if such a course has not previously been taken; (3) may not include, for credit, English 1, 2, 15, 16, or 23, or any courses in Rhetoric except 12, 15, 16, and 20; (4) must satisfy the department of the candidate's ability to write acceptable English.

As a rule, candidates must take the regular semester examinations in all their courses. They must also take special examinations as follows: a written examination, lasting about three hours, which must cover not only the field of the courses taken, but also the general fields of English and American literature and the outlines of the history of the English lauguage; an oral examination, which shall be a final test of the candidate's general fitness and ability.

The Degree of Doctor of Philosophy in English.—In addition to the general rules and suggestions for all candidates for the degree of Doctor of Philosophy (see pp. 14 to 17), the following departmental rules and suggestions are to be noted.

From the following list of topics grouped below there must ordinarily be chosen:

By all:	the whole of G, H, and I, either 4 or 5 in Group A, Beokulf, Chaucer, Skapspere, and Milton.
By those whose main interest lies in Group B:	All of A, B, and C; 3 from D; 2 from E; 2 from F.
By those whose main interest lies in Group C:	3 from A; all of B and C; 4 from D; 2 from E; 2 from F.
By those whose main interest lies in Group D:	1 from A; 2 from B; 2 from C; all of D; 3 from E; 3 from F.
By those whose main interest lies in either Group E or Group F:	1 from A; 2 from B; 2 from C; 3 from D; all of E and F.

Group A

1. Gothic.
2. Old French.
3. Old Norse.
4. History and Principles of English Grammar.
5. History of the English Language.

Group B

1. Anglo-Saxon Language and Versification.
2. Anglo-Saxon Prose.
3. Beowulf.
4. Other Anglo-Saxon Poetry.

Group C

1. Middle English: Language.
2. Middle English Literature: Ballads.
3. Middle English Literature: Romances.
4. Middle English Literature: Chaucer.
5. Middle English Literature: Lydgate, Gower, Wyclif, etc.
6. Middle Scottish Language and Literature.

Group D

1. Drama before Shakspere.
2. Shakspere.
3. The Drama from Shakspere to 1642.
4. Elizabethan and Jacobean Non-Dramatic Poetry.
5. Elizabethan and Jacobean Prose.
6. Milton

Group E

1. The Period of Dryden.
2. The Period of Pope.
3. The Period of Johnson.
4. American Literature to 1800.

Group F

1. The Earlier Romantic Movement.
2. The Period of Wordsworth.
3. The Period of Tennyson.
4. American Literature since 1800.

Group G

1. The History and Principles of Literary Criticism, especially of English Literary Criticism.
2. The History and Principles of English Versification.

Group H

1. English and American History in Outline.
2. A much more thorough knowledge of the history of England during the period upon which the candidate concentrates his attention. (If the candidate's special interest is in American literature, both English and American history will be required).
3. A fair knowledge of the history, during the period upon which the candidate concentrates his attention, of the country which is then most closely related to English literature.
4. A general knowledge of the history of modern philosophy.
5. A much more thorough knowledge of philosophy during the period upon which the candidate concentrates his attention, with special reference to England and to that country whose literary relations with England are closest at that time.

Group I

1. A reading knowledge of French and German.
2. A general knowledge of Greek and Latin literature and mythology.
3. A general acquaintance with that literature which during the period upon which the candidate concentrates his attention stands in closest relation to English literature.

Courses for Graduates

101. RESEARCH IN SPECIAL PERIODS.

A. Anglo-Saxon Languages and Literature. Professor DODGE

B. Thirteenth and Fourteenth Centuries. Dr. JONES.

C. Sixteenth Century. Professor DODGE, Dr. SHERMAN.

D. Seventeenth Century. Assistant Professor BALDWIN.

E Eighteenth Century. Professor GREENOUGH.

F. Nineteenth Century. Associate Professor FULTON.

106. AMERICAN LITERATURE. *Three times a week. I; II.** Professor GREENOUGH

109. THE HISTORY AND PRINCIPLES OF ENGLISH GRAMMAR — *Three times a week. I; II.* Dr. ZEITLIN.

*These figures mean first and second semesters.

125. Chaucer.—Critical Reading. *Three times a week. I; II.* Dr. Jones.

126. English Ballads and Metrical Romances.—*Three times a week. I. II.* Dr. Jones.

Students who elect English 126 are advised to take either with or before it English 125 (Chaucer) and Romance Languages 102 (Old French).

127. Middle English.—Critical reading in Middle English texts. *Three times a week. I; II.* Dr. Jones.

136. The Transition from the Seventeenth to the Eighteenth Century in English Literature.—*Three times a week. I; II.* Professor Greenough.

The attention of students who intend to take English 136 is called to History 4 (English Constitutional History), French 14 (Classic French Drama), Philosophy 4, (Modern Philosophy), Philosophy 15 (The Philosophical Thought of England in the Eighteenth Century).

137. Nineteenth Century Prose Writers. *Three times a week. I; II.* Dr. Sherman.

The attention of students who intend to take English 137 is called to Philosophy 4 (Modern Philosophy), Philosophy 10 (Thought Movements in the Nineteenth Century) and History 20 (Europe in the Nineteenth Century). (Not given in 1909-10).

138. The History of English Prose Fiction.—*Three times a week. I; II.* Professor Greenough.

139. The Romantic Movement in England.—*Three times a week.* Dr. Sherman.

The attention of students who intend to take English 139 is called to History 7 (The Revolutionary and Napoleonic Era).

Courses for Graduates and Advanced Undergraduates

Graduate students may offer these courses as part of major or minor work. The former are marked "grad. maj." the latter, "grad. min."

4. (Formerly Rhetoric 19). The History and Principles of English Versification.—Theory of English metre and rhythm; history of the development of the forms of English verse. *Twice a week. II.* Mr. Scott. (Grad. Min.)

(Not given in 1909-10.)

5. Shakspere and His Predecessors.—*Three times a week. I, II.* Professor Dodge. (Grad. Maj.)

6. (Formerly Rhetoric 18). The History of Criticism.—A study of the main lines of development in the history of criticism, with special attention to Greek, and English critics. *Four times a week. II.* Associate Professor Fulton. (Grad. Maj).

10. Anglo-Saxon Poetry.—*Three times a week. I, II.* Professor Dodge. Grad. Maj.)

11. (Formerly Rhetoric 17). The Principles of Criticism.—A study of the principles underlying the art of criticism. *Three times a week. I.* Associate Professor Fulton. (Grad. Min.)

Students who take English 11 are advised to take either before or with it Philosophy 8 (Esthetics).

17. The History of the English Language.—*Twice a week. I, II.* Associate Professor Fulton. (Grad. Min.)

33. English Poetry of the Nineteenth Century.—*Three times a week. I, II.* Dr. Zeitlin.

Students who intend to take English 33 are advised to take either with or before it History 7 (The Revolutionary and Napoleonic Era) and History 20 (Europe in the Nineteenth Century).

Rhetoric

17. English Composition.—*Three times a week. II.* Associate Professor Sherman.

Prerequisite: 9 hours of rhetoric (which must include either Rhetoric 3 or one semester of Rhetoric 20), and 14 hours of English literature.

GERMAN

Courses for Graduates

101. The Seminary in Germanic Philology is conducted by Professor Goebel. The work is adapted to the abilities and tendencies of the students. The primary object is to give training in original research. The results of the work, when of value, may be published in the *Journal of English and Germanic Philology*. The subject for 1909-10 will be Uhland's hoch- und neiderdeutsche Volkslieder . *Twice a week, I. II.*

103. Introduction to the Historical Study of the Germanic Languages.—Lectures; discussions of special topics. History of German philology. Comparative grammar of the German dialects. *Twice a week. I.* Professor Goebel.

104. Gothic.—An introductory study of its grammar and literature. *Twice a week. II.* Professor Goebel.

105. Old High German.—Grammar and interpretation of the oldest literary documents. *Twice a week. II.* Dr. Wiehr.

106. Middle High German.—Grammar and interpretation of selected texts. Especially recommended to candidates for teachers' certificates. *Twice a week. I.* Professor Goebel.

109. German Literature from 1786 to 1805.—This course will include Goethe's Italian journey, the period of Goethe's and Schiller's friendship, the birth of the Romantic movement. Especial attention will be given to the influence of Goethe and Schiller upon each other as shown by their correspondence and by their works during this period. *Three times a week. II.*

Assistant Professor Meyer.

110. Early German Drama.—The development of the German drama up to the Reformation, including the medieval religious drama, the Shrovetide plays and the beginnings of the humanistic drama. *Twice a week. I.* Assistant Professor Brooks.

113. German Literature of the Fifteenth and Sixteenth Centuries.—Survey of the literature on the background of the general history of the time. Luther and the Reformation, Mastersingers and Folksong, the Reformation drama, Hans Sachs, Brant, Fischart, the chap books, the English Comedians. *Three times a week. II.* Assistant Professor Brooks.

115. History of German Literature from Goethe's Death to the Present Time. *Twice a week. I, II.*

Associate Professor Lessing.

116. History of Literary Criticism in Germany. *Three times a week. II.* Associate Professor Lessing.

117. History of German Literature During the Eighteenth Century.—*Twice a week. I.* Professor Goebel.

118. Studies in the History of the German Drama with special reference to Kleist and Grillparzer. *Twice a week. I, II.*

Associate Professor Lessing.

119. History of the German Novel. *I, II.* Dr. Eckelmann.

121. Nieblunglied. Lectures and Interpretations.—*Twice a week. II.* Professor Goebel.

121. Edda.—Lectures and study of the heroic lays in their relation to the Nibelungensaga. *Twice a week. II.* Professor Goebel.

123. The Romantic School.—The literary side of early Romanticism. *Twice a week. I.* Dr. Wiehr.

Courses for Graduates and Advanced Undergraduates

8. Schiller.—The life of Schiller and study of Wallenstein and other selections. *Three times a week. I.* Associate Professor Lessing.

9b. Goethe.—Schiller.—Interpretation of Goethe's Poems, Goethe's Tasso and Schiller's Ueber naive und sentimentalische Dichtung. *Twice a week. I, II.* Professor Goebel.

11. History of Modern German Literature.—Lectures, recitations, and reports on assigned collateral readings. *Three times a week. II.* Associate Professor Lessing.

26. German Literature Before the Reformation.—Lectures recitations, and reports on assigned reading. This course is intended to cover the period not included in course 11, and students who intend to take course 11 are advised to elect course 26. *Three times a week. I.* Associate Professor Lessing.

27. Lessing.—The life of Lessing and study of Nathan der Weise, Emilia Galotti, and other selections. *Three times a week. II.* Associate Professor Lessing.

29. Advanced Prose Composition.—An advanced teachers' course aiming to give some facility in idiomatic expression in speaking and writing German. Themes on Germany and German life, based on suitable reading, discussed in German. *Twice a week. I, II.* Dr. Wiehr.

Scandinavian Languages

Courses for Graduates

101. Old Norse.—Introduction to the language as a member of the Germanic group. Reading of the Volsungasaga with selections from the heroic lays. *Twice a week. I, II.* Assistant Professor Flom.

The study of the old Germanic dialects may begin with this course.

103. Advanced Old Norse.—A critical study of the lays of the

Elder Edda. First semester, mythological lays, second semester, heroic lays *Twice a week. I, II.* Assistant Professor FLOM.

Prerequisite: Course 101.

This course is offered for 1910-11, and will thereafter alternate with a course in Old Danish and Old Swedish of one semester each.

Courses for Graduates and Advanced Undergraduates

11. SURVEY OF THE HISTORY OF THE SWEDISH LANGUAGE AND LITERATURE.—A course of lectures which will aim to present in outline the development, especially of the literature, from the time of the runic inscriptions down to Tegnér's death. *Twice a week. I.* Assistant Professor FLOM.

12. NORSE MYTHOLOGY.—An outline of the religious beliefs of the Norsemen in the pre-Christian times, and interpretation of the principal myths with reference to origin and meaning. *Twice a week. I.* Assistant Professor FLÓM.

ROMANCE LANGUAGES

FRENCH

Courses for Graduates

101. THE XVth AND XVIth CENTURIES IN FRANCE.—*Twice a week. I, II.* Associate Professor CARNAHAN.

102. OLD FRENCH READINGS.—First semester: Chrétien de Troyes and the court epic. Second semester: Readings from Marie de France, the prose chroniclers and the dramatists of the middle ages. *Twice a week. I, II.* Professor OLIVER.

103. OLD FRENCH PHONOLOGY AND MORPHOLOGY.—Development of Old French from Vulgar Latin. *Twice a week. I, II.* Associate Professor CARNAHAN.

125. SEMINARY.—An opportunity is given here for research in special fields of French and other Romance literatures.

Courses for Graduates and Advanced Undergraduates

10. GENERAL SURVEY OF FRENCH LITERATURE.—An introduction to more extended study of special periods and authors. The student becomes acquainted with some of the literary masterpieces of France and with the main currents of French literature from the beginnings to the present time. *Twice a week. I, II.* Dr. JONES.

This course is strongly recommended to those who desire the endorsement of the department to teach French.

11. Victor Hugo and the Lyric Poets of France.—Rise and growth of lyric poetry in France. The chief emphasis falls upon Victor Hugo, although the poets previous to Hugo and also his contemporaries receive attention. The principles of French versification are studied and illustrated, particularly in examples of Victor Hugo's poems. *Twice a week. I,* Dr. Jones.

(Not given in 1909-10).

21. Modern French Novelists.—A study of the novel in French from the beginning of the nineteenth century to the present time. Rapid translation and sight reading. Hugo, de Vigny, Dumas, Balzac, Flaubert, Daudet, Zola, and living writers. Lectures. Reports on collateral reading. *Twice a week. I, II.*

Associate Professor Carnahan.

24. The Seventeenth Century.—A study of the greater masterpieces of literature of the seventeenth century in France, with especial emphasis upon the drama. *Twice a week. I, II.*

Professor Oliver.

25 Course for Teachers.—Professor Oliver with the coöperation of Associate Professor Carnahan and other members of the department. *Once a week. I.*

Course for Graduates

Provençal

112. Old Provençal.—A study of the transformation of Vulgar Latin into Provençal, and of the poetry of the troubadours. *Once a week. I, II.* Assistant Professor Fitz-Gerald.

Italian

Courses for Graduates

115. Old Italian Readings and Italian Historical Grammar.—*Twice a week. I, II.* Dr. Jones.

Spanish

Courses for Graduates

118. The Early Spanish Satirists.—Juan Ruiz, Archpriest of Hita, and Martinez de Toledo, Archpriest of Talvera. *Once a week. I.* Dr. Seymour.

119. Early Religious Poetry.—Berceo's works will be the basis of this course. *Once a week. II.* Dr. Seymour.

120. Old Spanish.—Reading of the older monuments of Spanish literature. Phonetics and syntax of the languages. *Once a week. I, II.* Assistant Professor Fitz-Gerald.

Courses for Graduates and Advanced Undergraduates

10. The Spanish Novel of the Sixteenth and Seventeenth Centuries.—Iufluence on the English novel. Lazarillo de Tormes and other picaresque novels. Cervantes. *Twice a week. I.* Dr. Seymour.

11. Classic Spanish Drama.—Lope de Vega, Tirso de Molina, Calderon, and Ruiz de Alarcon. Schack's Spanish Dramtatic Literature. *Twice a week. II.* Dr. Seymour.

17. Don Quijote.—A critical study of the work, using facsimile editions of original texts. *Twice a week. I.* Assistant Professor Fitz-Gerald.

THE CLASSICAL LANGUAGES

Greek

Courses for Graduates

101. Greek Oratory. Professor Moss.

104. Homer and the Homeric Question.—The Iliad entire and parts of the Odyssey; lectures and assigned readings. *Twice a week. I, II.* Associate Professor Oldfather.

Courses for Graduates and Advanced Undergraduates

7. Socrates as Depicted by Xenophon, Aristophanes, and Plato.—Xenophon's Memorabilia, Aristophane's Cluds, Plato's Protagoras, Georgia, Euthyphro. Apology and Crito. *Three times a week. I, II.* Associate Professor Oldfather.

10. Greek Tragedy.—*Twice a week. I.* Professor Moss.

12. Thucydides.—*Twice a week. II.* Professor Moss.

14. Advanced Greek Prose Composition.—*Once a week. I.* Professor Moss.

Latin

Courses for Graduates

101. General Introduction to the Science of Language.—*Twice a week. I.*

102. Historical Latin Grammar.—Historical treatment of inflections and sounds of Latin in its relation to the other Indo-European languages. *Twice a week. II.*

103. CICERO.—De Natura Deorum and De Divinatione. *Three times a week. I.* Assistant Professor PEASE.

105. SURVEY OF LATIN POETRY.—*Three times a week. II.* Assistant Professor PEASE.

106. LATIN COMEDY OF PLAUTUS AND TERENCE.—Lectures and readings. Two plays will be discussed in detail as an introduction to the methods of critical research and a large number read rapidly. *Twice a week. I, II.* Associate Professor OLDFATHER.

108. TACITUS.—The Histories. *Twice a week. II.* Professor BARTON.

(Not given in 1909-10).

Courses for Graduates and Advanced Undergraduates

7. PROSE OF THE EMPIRE.—Selections from Petronius and Apuleius. The Roman novel. *Twice a week. II.*

14. SENECA.—Selections from his prose; two tragedies. *Three times a week. I.* Professor BARTON.

16. VERGIL.—*Three times a week. II.*

B. History and the Social Sciences

HISTORY

Advanced courses in history at the University of Illinois are of three kinds: 1. Instruction in methodology, historiography, and bibliography. This work is done at present by the co-operation of various instructors in course 103 described below, and is required of all graduate students in history during their first year. 2. Seminary courses for the study of special fields with a view primarily to training in the methods of historical criticism and research. 3. Courses for information and guidance in general reading.

Research or seminary work in history is offered in the following fields: American history with special reference to institutions and western development; English history with emphasis upon medieval institutions of the eighteenth century; modern European history with special reference to the rise of Prussia and the revolutionary and Napoleonic era. Research topics in these special fields will commonly be arranged in cycles so that a new topic may be taken up in each of the three years devoted to graduate work.

A student entering upon graduate work should have had at least the equivalent of the introductory college courses in English, continental European, and American history.

Emphasis is laid upon linguistic preparation. All historical students should have at least a reading knowledge of German and French; for medieval history some knowledge of Latin is indispensable, and in certain fields of American history Spanish is needed. The requisite reading knowledge of French and German must be shown before the student enters on his second year of graduate work.

As illustrating the resources of the library for historical purposes the following items may be noted: In American history there are strong collections of colonial and federal documents, of the writings of statesmen, and such periodicals as Niles' Register. As the result of recent acquisitions the collection is especially rich in contemporary material dealing with the American Revolution and the history of the west in the eighteenth century. In English history there are such standard sets as the Statutes of the Realm, the Parliamentary Debates, the Rolls Series, the Calendar of State Papers, and the Reports of the Historical Manuscripts Commission. The library has also purchased recently some of the important collections in the field of Continental Empire history.. A valuable addition to the resources of the department is the library of western history collected by the late Edward G. Mason, a former president of the Chicago Historical Society, but now constituting the Mason Collection of the Champaign Public Library. Attention is also called to the fact that the University of Illinois has for some time co-operated with the Illinois State Historical Society and the trustees of the State Historical library, in the gathering and editing of archive material. As a result of this relation instructors and graduate students in the department have, from time to time, made important contributions to the publications of these state organizations, and have been given useful training in the study of printed, as well as manuscript material. During the past year the University has been accumulating transcripts of papers in the English Archives.

As a means of mutual stimulus the Historical Club has been organized, consisting of instructors and graduate students in the department. The monthly program is devoted to reviews of current progress in historical work and from time to time members report the results of their own investigations.

Courses for Graduates

101. Seminary in American History.—The work of this

course is of two kinds. The first consists of general exercises in which all the members of the class are expected to take part. In these exercises some attention will be given to the general bibliography of American history; but a large part of the time will be devoted to the cooperative study of typical problems. The problems selected for this purpose in 1909-10, will be drawn from the American revolutionary era, 1763-1783. The second part of the seminary work will consist of the preparation of a thesis, based upon the results of original research. *I, II.*

Professor GREENE and Assistant Professor ALVORD.

102. STUDIES IN ENGLISH HISTORY.—The purpose of this course is to provide an opportunity for a closer study of some of the more important periods and movements of English history. The first semester of the year 1908-1909 was devoted to the study of the leading twelfth century chronicles; the second to the study of colonial expansion and colonial policies in the eighteenth century. *Three times a week. I. II.* .. Assistant Professor LARSON.

103. HISTORICAL BIBLIOGRAPHY AND CRITICISM.—Selected problems in various fields are worked out under the guidance of the several instructors. Required of all candidates for an advanced degree in history who do not present evidence of similar training elsewhere. *Three times a week. I, II.*

Professor FORD, assisted by other members of the department.

104. SEMINARY IN MODERN EUROPEAN HISTORY.—The subject selected for 1909-10 is the influence of the French Revolution in Germany. *Three times a week I, II;* or more at the option of the student and the instructor. Professor FORD.

105. THE HISTORY OF WESTERN EXPANSION, 1763-1818.—The period indicated is covered by lectures and readings, but the main object of the course is the study of various problems in the interpretation of western history. *Three times a week. I, II.*

Assistant Professor ALVORD.

106. THE FORMATION AND DEVELOPMENT OF BRANDENBURG-PRUSSIA FROM 1640-1786.—This gives an opportunity for somewhat detailed study of the work of the Great Elector, Frederick William I., and Frederick the Great. *Three times a week. I, II.*

Professor FORD.

107. SELECTED TOPICS IN THE HISTORY OF THE NINETEENTH CENTURY.—This course does not aim at a connected presentation of

the whole period. Certain events, persons, and movements are selected for intensive study. *Three times a week. I, II.*

Professor Ford.

(Not given in 1909-10).

108. French Institutional History During the Seventeenth and Eighteenth Centuries.—The gradual development of the institutions of the centralized government is treated by means of a careful study of their fundamental laws. In a similar manner the methods adopted to promote economic development, particularly those concerned with commerce and colonial expansion, are studied. *Three times a week. I.* Assistant Professor Alvord.

109. The History of the French Colonies in America.—The history of French exploration and settlement in America is studied, as far as possible, in the primary sources. Particular attention is given to institutions and to the discovery and colonization of the Mississippi Valley. *Three times a week. II.*

Assistant Professor Alvord.

110. The Spanish-American Revolution.—A detailed study of the movements which culminated in the independence of the Spanish-American states. *I.* Assistant Profesosr Robertson.

111. Spanish-American Diplomacy.—A consideration of the problems which have arisen in the relations of the leading Spanish-American states with Europe and the United States. *II.*

Assistant Professor Robertson.

History 110 and 111 are open only to students who possess a reading knowledge of the Spanish language.

112. Selected topics in the Social and Religious History of the American Colonies in the Eighteenth Century. *II.*

Professor Greene.

Courses for Graduates and Advanced Undergraduates

(The ability to use French and German is desirable in all of these courses and is essential in some of them).

4. Constitutional History of England.—During the first semester, the emphasis is placed on institutional origins; in the second semester particular attention is given to modern constitutional practice. *Three times a week. I. II.* Assistant Professor Larson

8. Medieval Culture.—The main object of this course is to trace the intellectual development of medieval civilization. In the period of transition from pagan to Christian culture typical figures

like St. Augustine, Boethius, and Gregory the Great are studied in some detail. In the twelfth and thirteenth centuries prominence is is given to such topics as the strife over investitures, the crusades, rise of universities, vernacular literature, development of Gothic architecture, and scholasticism. *Three times a week. I.* Dr. PAETOW.

9. THE ERA OF THE RENAISSANCE.—The political, religious, and economic history of Europe during the fourteenth and fifteenth centuries is considered, as well as the intellectual and artistic revival. This course is designed to be a continuation of course 8, although either may be taken separately. *Three times a week. II.* Dr. PAETOW,

13. AMERICAN REVOLUTION, 1760-1783.—The following topics will be considered: The American people and their institutions at the close of the colonial era; the causes of the Revolution, 1760-1775; a survey of the war period, 1775-1783, with special emphasis on the economic, social, and political changes, rather than upon military and diplomatic transactions. *Three times a week. I.*

Professor GREENE.

14. THE MAKING OF THE FEDERAL CONSTITUTION.—This course provides for an intensive study, based upon original material, of the events from 1783-1789, which resulted in the framing and ratification of the federal constitution. Special attention is given to the proceedings of the federal convention of 1787 and the contemporary arguments for and against the ratification of the Constitution. *Three times a week. I.* Professor GREENE.

(Not given in 1909-10).

15. THE CIVIL WAR AND THE RECONSTRUCTION OF THE SOUTHERN STATES.—This course begins with a careful study of life and institutions in various sections of the country just before the secession of the southern states. In the treatment of the civil war, stress is laid upon political and economic conditions rather than upon military campaigns. In the treatment of the reconstruction period, emphasis is laid upon southern conditions. *Three times a week. II.* Professor GREENE.

22. AMERICAN HISTORY, 1820-1860.—An intensive study of the period including social as well as political history. *Three times a week. II.* Professor GREENE.

(Not given in 1909-10).

26. THE MODERN HISTORY OF SPAIN.—A rapid survey of the early history of Spain, followed by a closer study of the modern

period. This course is intended to furnish a background for the study of Spanish colonization in America. *I.*

Assistant Professor ROBERTSON.

Prerequisite: Ten hours in history, including History 1. A reading knowledge of Spanish is also very desirable.

27. THE HISTORY OF LATIN AMERICA AND THE PHILIPPINES.—During the first semester the topics covered will be as follows: The discovery and exploration of the New World; the settlement, administration, and civilization of the Latin-American colonies; the struggles for independence. During the second semester the course will provide a general survey of the history of the leading Latin-American countries since their separation from Europe. *Three times a week. I, II.* Assistant Professor ROBERTSON.

Prerequisite: Ten hours in history, including History 3. A reading knowledge of Spanish is also very desirable.

ECONOMICS

Every student entering upon graduate work in economics must have had a thorough course in the principles of the science and should also have studied some special part of the field of economics, such as public finance or money and banking.

The department of economics includes general economics, economic history, finance, commerce and industry.

The library equipment of the department is one of the best in the country. Complete sets of all the important French, German, English, and American economic and financial journals are on hand, ninety periodicals, foreign and domestic, in economics, finance, commerce, industry, statistics, etc., are currently received. The department has recently purchased the duplicates of the collection of labor literature gathered by the Bureau of Industrial Research at Madison, Wisconsin. This collection, with what was already in the University library, affords a large amount of valuable material for original research. The library is unsually strong in railroad literature, economic history, finance and general theory.

Courses for Graduates

101. RECENT ECONOMIC THEORY.—*I, II. Twice a week.* Professor KINLEY.

(Not given in 1909-10).

102. Advanced General Economics.—An advanced course covering the whole field with detailed discussion of certain parts. *Twice a week. I, II.* Professor Kinley.

103. Seminary in Railway Administration.—Advanced students in this subject make an investigation of some aspect of railway administration. *I, II.* Professor Dewsnup.

104. Seminary in Commerce.—A study of present international commercial relations, with special reference to the trade conditions of the United States and the extension of her trade in foreign markets.. *I, II.* Dr. Litman.

105. Public Finance.—*Twice a week. I. II.* Assistant Professor Weston.

(Not given in 1909-10).

106. Railway Policy.—A study of various railway policies and problems in the United States and abroad. *Once a week. I, II.* Professor Dewsnup.

107. The Corporation in Economic Evolution.—*Once a week. I, II.* Professor Robinson.

(Not given in 1909-10).

108. Comparative Corporation Organization.—*Once a week. I, II.* Professor Robinson.

118. Seminary.—The special subject of study for 1909-10 will be announced in due course. *I, II.* Professor Kinley and others.

120. History of Economic Thought.—*Twice a week. I, II.* Dr. Thompson.

(Not given in 1909-10).

122. Advanced Economic History of the United States.—In this course an effort will be made to show the part which economic factors have played in the history of our country. The connection between economic and political movements will be noted, and careful studies will be made of particular phases of our economic history, such as the westward movement and the settlement of the public lands. The seminary method will be followed, and each student will prepare during the semester at least one thesis on an assigned topic which will be read and discussed in class. *Twice a week. I. II.* Associate Professor Bogart.

Courses for Graduates and Advanced Undergraduates

4. Financial History of the United States.—A study of colonial and federal finance, including currency, banking, tariff and fiscal questions and a brief survey of the development of the finan-

cial systems of some of the leading states, as New York and Illinois. *Three times a week. I.* Assistant Professor WESTON.

Prerequisite: Economics 1, 3; History 3.

(Not given in 1909-10).

10. CORPORATION MANAGEMENT AND FINANCE.—*Three times a week. I.* Professor ROBINSON.

Prerequisite: Economics 1 and 3, or (for engineers) 2 and 16a.

11. INDUSTRIAL CONSOLIDATIONS.—The development of industrial consolidations; the growth of monopoly; monopoly prices and methods; the ability of trusts to affect prices, wages, interest, and profits; and the proposed plans for controlling trusts. *Three times a week. II.* Professor ROBINSON.

Prerequisite: Economics 10.

12. THE LABOR PROBLEM.—*Three times a week. I, II.* Dr. TOWLES.

Prerequisite: Economics 1 and 3.

21. SOCIALISM AND SOCIAL REFORM.—*Three times a week. II.* Dr. TOWLES.

Prerequisite: Economics 12.

29. FOREIGN COMMERCE AND COMMERCIAL POLITICS.—A study of the various commercial systems, mercantile, free trade and protective, etc. *Three times a week. II.* Dr. LITMAN.

Prerequisite: Economics 28.

(Not given in 1909-10).

31. HISTORY OF THE COMMERCIAL RELATIONS OF THE UNITED STATES.—This comprises a study of the general trade relations of the United States with foreign countries as well as a more detailed consideration of our commercial relations with certain countries. It is desirable, though not required, that this course be taken in connection with 35. *Twice a week. II.* Dr. LITMAN.

Prerequisite: Economics 1, 7, 26, and six hours of modern history.

35. CONSULAR AND DIPLOMATIC SERVICE.—The basis of this course is the consular and diplomatic relations of the United States. Some attention, however, is paid to the foreign service of other important countries. *Three times a week. II.* Dr. LITMAN.

Prerequisite: Economics 28, 29, 30.

43.—TRAFFIC ADMINISTRATION.—The work of the freight and passenger traffic departments. *Three times a week. I.* Professor DEWSNUP.

Prerequisite: Economics 1; for engineers 2.

44. Railway Transportation.—The train service, train dispatching and the block system of train working are emphasized. *Twice a week. II.* Professor Dewsnup.

Prerequisite: Economics 1; for engineers 2.

45. Railway Practice.—A careful study of the design of steam tracks, freight houses, and yards, with reference to economy and expedition of operation; methods of operation; fast freight service; car service and demurrage arrangements; the economics of railway location and operation. *Twice a week. I.*

Professor Dewsnup.

Prerequisite: Economics 42.

47. Foreign Railway Systems.—A general study, each year, of some one foreign railway system. *Twice a week. II.*

Professor Dewsnup.

Prerequisite: Economics 44 and 45.

SOCIOLOGY

Preparation for graduate work in sociology should include the principles of economics and psychology, together with history. Unless the undergraduate preparation has also included the subject matter treated in one or more of the courses numbered 1, 2, 3 and 4, none of those courses may be omitted by a graduate student whose major subject is sociology.

Courses for Graduates

101. Sociological Method.—A study of the method of advancing the science of sociology including a discussion of the adaptability to sociological investigation of the methods described in certain important works on methodology, for example, Pearson's Grammar of Science, Wundt's Methodenlehre, erster und vierter Abschnitt, Seignobos' La Methode Historique Appliquée aux Sciences Sociales. *Three times a week. I.* Professor Hayes.

(Not given in 1909-10).

102. The Development of Sociology.—A reading course in the original works of the writers who have contributed most to the development of sociology, accompanied by discussions with the instructor. *Three times a week. I. II.* Professor Hayes.

150. Seminary.—The subjects pursued in seminary vary from

year to year. The chief aim is to develop initiative and skill on the part of the students themselves, in the matters of investigation. *One session of two hours each week. I. II.* Professor HAYES.

Courses for Graduates and Advanced Undergraduates

1. GENERAL SOCIOLOGY.—Essential points of view involved in the application of scientific method to social interpretation, and certain fundamental concepts and main teachings of sociology. *Three times a week. I.* Professor HAYES.

2. SOCIAL CONTROL AND SOCIOLOGICAL ETHICS.—An explanation of the methods by which society controls the conduct, beliefs, and desires of its members, by law, religion, education, public opinion, and other agencies; together with a study of the rational motives of conduct. *Three times a week. II.* Professor HAYES.

3. COMPARATIVE AND GENETIC SOCIOLOGY.—A description and comparison of different modes of activity (economic, political, legal, ethical, religious, domestic, etc.) as they prevail or have prevailed among people at different stages of progress, savage, barbarous and civilized; inductions from such facts; including a theory of social evolution, and of the method of progress. *Three times a week. I.* Professor HAYES.

4. PSYCHOLOGICAL SOCIOLOGY.—The conditioning of social activities by each other; public opinion, public sentiment, leadership, mobs, fashions, custom, conventionality, periods of social productivity and decay, etc. *Three times a week. II.* Professor HAYES.

5. CHARITIES AND CORRECTIONS.—The cause, prevention, and treatment of poverty and crime. *Three times a week. II* Professor HAYES.

THE LABOR PROBLEM.—Identical with Economics 12.

SOCIALISM AND SOCIAL REFORM.—Identical with Economics 21.

POLITICAL SCIENCE

Graduate work in political science embraces the following special fields: (1) Comparative Government; (2) Public Administration and Administrative Laws; (3) International Law and Diplomacy; (4) Constitutional Law; and (5) Political Theory.

No student is considered qualified to carry graduate work in political science who has not had at least the equivalent of the introductory college courses in government and history. A reading knowledge of German and French is highly desirable, and in some

of the courses it is indispensable. Attention is called to the fact that recently extensive additions to the library equipment have been made so that the facilities for research work in political science are now believed to be ample for ordinary purposes.

Courses for Graduates

101. Municipal Administration.—This is an advanced course dealing in the first semester, with the development of cities, the organization of municipal government and its relation to the central government, and political methods and reform movements in cities. Comparison is made between conditions in the United States and European countries and recent tendencies in this country discussed.

In the second semester, an examination is made of municipal functions in the United States and Europe, including police, fire, and health departments, schools, and charities, municipal public works, street railways, lighting plants, etc. The work of each semester may be taken independently of the other. *Three times a week, I. II.*

Associate Professor Fairlie.

102. The Nature of the State.—The principles, methodes, and relations of political science; the origin, nature, forms, and functions of the state; sovereignty and liberty; citizenship and nationality; constitutions, principles of political organization, etc. *Once a week. II.*

Professor Garner.

103. Seminar in Political Science and Public Law.—Research work in the investigation of special problems. Presentation of reports followed by discussion and criticism. The research work of candidates who are writing theses will be under the personal supervision of some individual instructor to whom the candidates will be expected to report from time to time. *I. II.*

Courses for Graduates and Advanced Undergraduates

2. European Governments.—A comparative study of the national political systems of Great Britain, France, Germany, Italy, Austria-Hungary and Switzerland, with special reference to constitutional beginnings, political organization, methods of legislation and administration, and constitutional guarantees for the protection of individual rights. *I.*

Professor Garner.

5. The Federal Constitution.—An exposition and analysis of the federal system of the United States through a study of the origin and nature of the federal constitution and its development through judicial interpretation. The constitution in its relation to

the geographical divisions of the United States; the jurisdiction of the federal courts; state and national citizenship; the powers of the national government and constitutional limitations on those of the states; the effect of later amendments on the federal system. Study of leading cases supplemented by text book work and lectures. *Three times a week. I.* Mr. Powell.

6. International Law.—The development of the law of nations; its nature, source, and present status; the equality of states; the doctrine of intervention; the laws of war and peace; the rights and duties of neutrals; the arbitration movement. Lectures, assigned readings and reports. *Three times a week. II.* Professor Garner.

7. American Diplomacy.—A study of the genesis and present organization of the Department of State; the diplomatic service; the treaty making power; the methods and traditional principles of the foreign policy of the United States; historical review of the principal diplomatic controversies between the United States and foreign powers from the foundation of the government to the present time; the rise of the United States to the position of a world power. *Twice a week.. I.* Professor Garner.

8. The Law of Taxation.—Constitutional limitations on the taxing power, state and federal; legal rules governing assessment and collection of taxes. *Twice a week. I.* Mr. Powell.

10. Administrative Law.—The nature of administrative law and its relation to constitutional law; the principle of the separation of powers as a rule of law; judicial control over administrative officials; legal powers and liabilities of public corporations as administrative authorities. Study of cases, text book work, and lectures. *Three times a week. II.* Mr. Powell.

11. Public Officers.—The nature of public office; formation and termination of the official relation; judicial control over the appointment, election, qualification and removal of public officers; the exercise of official authority; legal liability of officers; extraordinary legal remedies. *Twice a week. II.* Mr. Powell.

12. National Administration in the United States—A study of the President and Congress; the executive departments and the administrative services of the national government, including a survey of judicial administration and the relation of the courts to the administrative authorities. *Three times a week. I.*

Associate Professor Fairlie.

13. State and Local Administration in the United States.—

A study of the administrative powers of the state executive and legislature, of the state officers and institutions, and the systems of local government, including the relations between the state and local authorities and between the courts and administrative officials. *Three times a week. II.* Associate Professor FAIRLIE.

14. POLITICAL PARTIES—A study of the development of political parties and their organization and influence on the government mainly in Great Britain and United States, with attention to recent legislation in primaries and nomination methods in this country. *Twice a week. I.* Associate Professor FAIRLIE.

15. POLITICAL PHILOSOPHY.—Philosophical theories of the state, historical, critical, constructive. *Twice a week. II.* Mr. BECKER.

See Philosophy 5.

C—Philosophy, Psychology, and Education

PHILOSOPHY

Courses for Graduates

101. THE PHILOSOPHY OF PLATO AND ARISTOTLE.—*Twice a week. I, II.* Professor DANIELS.

(Not given in 1909-10).

102. SEMINARY.—Theory of knowledge. The methods and presupposition of knowledge in relation to present-day realism and pragmatism. *Twice a week. I, II.* Professor BODE.

Courses for Graduates and Advanced Undergraduates.

7. ETHICS.—The beginnings and growth of morality; analysis and criticism of the leading conceptions of moral theory; discussion of some typical social and economic problem of the present. *Three times a week. I.* Mr. BECKER.

8. ESTHETICS.—Theory of the appreciation of art and nature; place of such appreciation in life. (a) Primitive arts and appreciation. (b) Modifications of the esthetic (such as the sublime and the ugly). (c) Prime characteristics and relations of the various fine arts. *Three times a week. I.* Dr. NORTON.

11. HISTORY AND PHILOSOPHY OF RELIGION.—An historical and comparative study of religions. The philosophical interpretations of religious consciousness and a critical study of various religious concepts; God, revelation, inspiration, dogma, faith, prayer, immortality, the problem of evil, the relation of morality and religion. *Twice a week. I, II.* Professor DANIELS.

(Not given in 1909-10).

12. The Principles of Knowledge and the Method of Scientific Investigation.—An advanced course in real logic beginning with a thorough review of the principles of formal logic and the chief methodological presuppositions of the mathematical, the physical, the biological, the psychological, and the philosophical sciences. *Three times a week. I.* Mr. Becker.

14. Seventeenth Century Philosophy.—Descartes, Spinoza, and Leibrig. *Three times a week. II.* Mr. Becker.

15. The British Philosophers of the Eighteenth Century.—Locke, Berkeley, and Hume. *I. Three times a week.*

16. Kant.—The Critique of Pure Reason. *Twice a week. II.* Professor Bode.

PSYCHOLOGY

No student may do graduate work in psychology without having had courses 1 and 7, (elementary psychology), or their equivalent, and at least one three-hour course in philosophy.

Courses for Graduates

101. Research.—Opportunity to investigate advanced problems in experimental psychology, and in comparative and genetic psychology is offered to properly qualified graduate students. *I, II.*

102. Contemporary Literature.—The most important problems of contemporary psychology, with their historical bearings, will be presented and discussed. *Twice a week. I, II.* Professor Colvin.

111. The Psychology of the Intellectual Processes.—*Twice a week. II.* Assistant Professor Baird.

(Not offered in 1909-1910).

113. Abnormal Psychology.—The pathological aspects of consciousness; arrested mental development in children and mental disorders in later life. *Twice a week. I.* Dr. Kuhlman.

114. The Psychology of Memory.—Two lectures a week and two hours of laboratory demonstration. *Three times a week. II.* Dr. Kuhlmann.

Courses for Graduates and Advanced Undergraduates

(These courses are not open to freshmen or sophomores. Prerequisite at least six hours in elementary psychology).

3. Experimental Psychology.—The object of this course is

to train the student in laboratory methods, and to give him an intimate acquaintance with normal mental phenomena. Lecture and laboratory work, two two-hour periods a week. (The student should arrange to take his laboratory work in the afternoon; any day from 2 to 4). *Twice a week. I.* Assistant Professor BAIRD.

4. EXPERIMENTAL PSYCHOLOGY.—This course is a continuation of Course 3 and cannot be elected separately. Lectures and laboratory work two afternoons (2 to 4) a week. *Twice a week. II.*

Assistant Professor BAIRD.

5. GENETIC PSYCHOLOGY.—This course traces the mental development of the child from birth to maturity. The latter part is devoted to the phenomena of adolescence, and the intellectual problems confronting the youth. The development of the nervous system and growth of the body are traced in connection with the mental development. *Twice a week. II.*

Professor COLVIN, Dr. KUHLMANN.

6. COMPARATIVE PSYCHOLOGY.—This course aims at an analysis of animal behavior and its interpretation. Special attention will be given to the sensory equipment of animals, trophisms, instinctive behavior, acquired habits, the analysis of the learning process in animals, and animal intelligence. *Twice a week. I.*

Dr. KUHLMANN.

9. PHYSIOLOGICAL PSYCHOLOGY.—In this course the growth and structure of the central nervous system and of the sense organs are outlined, the characteristics of sensation and its place among the elements of consciousness discussed, and the functions and phychology of the various sense organs presented. The physiological basis of the emotions is also considered. *Twice a week. II.*

Assistant Professor BAIRD, Dr. CARPENTER.

12. MINOR PROBLEMS IN EXPERIMENTAL PSYCHOLOGY.—This is an advanced laboratory course in which special investigations are undertaken by advanced undergraduate students. *Two to five times a week. I, II.*

Professor COLVIN, Assistant Professor BAIRD, Dr. KUHLMANN.

EDUCATION

Courses for Graduates

101. SEMINARY IN THE PRINCIPLES OF EDUCATION.—*I.*

Professor BAGLEY, Dr. NORTON.

102. SEMINARY IN THE HISTORY OF EDUCATION.—*II.* Mr. ——

111. Practice-Teaching.—Students who desire to enroll in this course (which is based upon 11-c) must present, from the head of the University department representing the subject that they propose to teach, satisfactory evidence that they are qualified from the standpoint of subject-matter. Each graduate student taking this course must select, with the approval of the Department of Education, some problem of teaching or management upon which there is a division of opinion among educators, plan means for investigating this problem, and present a written report of his methods and results before the close of the term. Professor Bagley, Dr. Norton.

Courses for Graduates and Advanced Undergraduates

4. Contemporary Educational Conditions and Movements in the United States.—The interpretation of present tendencies as exemplified in the school systems of typical cities and states and in recent educational experiments in administration, discipline, methods, and subject matter. *Twice a week. I.* Dr. Norton.

Prerequisite: Education 1 and 2.

5. Comparative Study of the Secondary Schools of France, Germany, England, and the United States.—The different types of secondary schools in each country; conditions of their origin and development; their present status and relation to elementary schools and universities. *Twice a week. II.* Dr. Norton.

Prerequisite: Education 1 and 2.

11. Observation and Practice.—Students observe regularly and systematically the instruction in particular classes in the Academy and neighboring high schools. Students properly qualified are admitted to the training courses which involve practice teaching in the Academy. Such students are given complete responsibility for the conduct and progress of their classes, and do the actual work of the class room under the supervision of the faculty of the School of Education and the teachers of the Academy. *Three to five times a week. I. II.* Professor Bagley, Dr. Norton.

Prerequisite: Senior standing and at least eight hours in education.

13. Educational Classics.—A critical study of the sources of the history of education. The more important educational works of Plato, Aristotle, Quintilian, Montaigne, Milton, Locke, Rousseau, Pestalozzi, Herbart, Froebel, Spencer, and others are considered. *Three times a week. I.* Dr. Norton.

Prerequisite: Education 2 and Philosophy 3a and 4.

17. Herbartian Pedagogics.—The philosophy, psychology, and pedagogy of Herbart are critically studied and compared with other pedagogical systems. *Twice a week. I.* Dr. Norton.

Prerequisite: Education 3.

18. Principles of Esthetic, Moral, and Religious Education.—Values, ideals, and methods of each; their relation to each other, to intellectual training, and to the utilities of life; their effects on social and national life and on the general advancement of the fine arts; selection of the material of instruction, and the development of individual taste and conscience; the public school, the Sunday school, and other instrumentalities. *Three times a week. I.* Dr. Norton.

Prerequisite: Education 2 and Psychology 7.

20. Philosophy of Education.—*Three times a week. I.* Mr. —

Prerequisite: Education 1.

20a. Theory of Supervision.—A study of the problems of supervision with especial reference to the training and improvement of teachers. Open only to graduate students, to seniors who are either graduates of normal schools or experienced teachers, and to seniors who are preparing for the work of supervision in special subjects, such as household science, manual training, and physical training. *II.* Professor Bagley.

Prerequisite: Education 1, 6.

20b. Theory and Practice of Supervision.—Course with the addition of a period of actual practice in the constructive criticism of teaching, involving the test of principles as in Course 11. *II.* Professor Bagley.

Prerequisite: Education 1, 6.

21. Theory of Elementary Education.—A study of the problems, materials, and methods of the elementary school. Open only to graduates and to seniors who are either graduates of normal schools or experienced teachers. Especially planned to meet the needs of students who are preparing for principalships and superintendencies. *I.* Professor Bagley.

Prerequisite: Education 1, 6.

D.—Mathematics and the Physical Sciences.

MATHEMATICS

Courses for Graduates

101. Functions of Real Variables.—An introduction to the theory of functions of real variables, making use of the general principles of the theory of assemblages. The two courses in functions (24a, 101) are a continuation of the work done in calculus (8a, 8b, or 7, 9). *Three times a week. I, II.* Professor Townsend.

Prerequisite: Mathematics 8a, 8b, (or 7, 9), 10.

(Not given 1909-10; to be given 1911-12.)

102. Fourier's Series.—This course is intended for students both of pure mathematics and of the physical sciences. It consists of a brief consideration of the elementary theory of Fourier's and allied series, followed by detailed discussion of numerous physical applications and consideration of classical and recent researches concerning the properties of Fourier's series and operations upon them. *Three times a week. I. II.*

Assistant Professor Haskins.

Prerequisite: Mathematics 16.

103. Theory of Potential.—The elements of the theory of the logarithmic and Newtonian potential functions. Green's theorems and functions. Boundary value problems. Applications to physical problems. *Three times a week. II.* Assistant Professor Haskins.

Prerequisite: Mathematics 16.

(Not given 1909-10).

104. Expansions in Terms of Oscillatory Functions.—*Three times a week. I.* Assistant Professor Haskins.

Prerequisite: Mathematics 16.

(Not given 1909-10; to be given 1910-11).

110. Elliptic Functions.—The elements of the theory of elliptic functions with applications to geometry and mechanics. Introduction to the theory of the elliptic modular functions. *Three times a week. I, II.* Professor Townsend.

Prerequisite: Mathematics 24a.

(Not given 1909-10; to be given 1910-11).

111. Automorphic Functions.—An introduction to the theory of automorphic functions. The first semester will be devoted mostly to the group-theoretic side of the theory; the second semester will be concerned with the function-theoretic develop-

ments and applications. *Three times a week. I, II.*
Assistant Professor YOUNG.

Prerequisite: Mathematics 24a and preferably 27.

112. THEORY OF ABELIAN FUNCTIONS.—Discussion of the algebraic functions of a complex variable and their integrals, Reimann's surfaces, birational transformations, Abel's theorem with geometrical applications, the inversion problem and the theta functions. *Three times a week. I, II.* Associate Professor WILCZYNSKI.

Prerequisite: Mathematics 24a, 110.

(Not given 1909-10; to be given 1911-12.)

113. THEORY OF LINEAR DIFFERENTIAL EQUATIONS.—*Three times a week. II.* Assistant Professor YOUNG.

Prerequisite: Mathematics 24a.

(Not given in 1909-10; to be given 1911-12).

114. REAL SOLUTIONS OF DIFFERENTIAL EQUATIONS.—*Three times a week. II.* Assistant Professor HASKINS.

Prerequisite: Mathematics 16.

(Not given 1909-10; to be given 1910-11).

115. INTEGRAL EQUATIONS.—*Three times a week. I, II.*
Assistant Professor HASKINS.

Prerequisite: Mathematics 16.

(Not given 1909-10; to be given 1911-12).

120. ELEMENTARY THEORY OF GROUPS.—The study of the groups which present themselves in arithmetic, geometry and trigonometry is followed by a determination and study of those which can be represented with a smaller number of letters. The latter part of the course is devoted to the abstract group theory and the Galoss theory of equations. *Three times a week. I, II.*
Professor MILLER.

(Not given 1909-10; to be given 1910-11).

121. THEORY OF GROUPS.—Second course This course presupposes about one year's work in group-theory. It will be devoted to special topics depending upon the needs of the class. The early part of the course will be devoted to th consideration of recent advances and methods along these special lines, and it is hoped that the latter part may be used for research. *Three times a week. I, II.* Professor MILLER.

Prerequisite: Mathematics 120.

124. THEORY OF NUMBERS.—The principal subjects considered in this course are: congruences, Kronecker's modular systems,

quadratic residues, quadratic forms, and algebraic numbers. *Three times a week. I. II.* Professor MILLER.

(Not given 1909-10; to be given 1911-12).

129. THEORY OF STATISTICS.—The general methods of statistical investigation, the application of the theory of probability to statistical data, the fitting of the curves of observation, interpolation, theory of errors, and the mathematical theory of variability and correllation, the application of principles developed to problems in economics and biology. *Three times a week. I, II.*

Assistant Professor RIETZ

Prerequisite: Mathematics 8a.

130. INVARIANTS AND HIGHER PLANE CURVES.—This course includes the general theory of algebraic curves, together with the application of the theory of invariants to higher plane curves. Special study is made of curves of the third and fourth order. *Three times a week. I, II.* Dr. SISAM.

Prerequisite: Mathematics 8a, 8b, 11.

131. ALGEBRAIC SURFACES.—In this course are considered the application of homogeneous coördinates and the theory of invariants to geometry of three dimensions, and also the general theory of surfaces, together with the special properties of surfaces of the third and fourth order. *Three times a week. I, II.* Dr. SISAM.

Prerequisite: Mathematics 19a, 130.

(Not given 1909-10; to be given 1910-11).

135. METRIC DIFFERENTIAL GEOMETRY.—Applications of the calculus to the general theory of curves and surfaces based primarily on the use of Cartesian coordinates. Relation of the theory of surfaces to the theory of invariants of a pair of quadratic differential forms. *Three times a week. I, II.*

Associate Professor WILCZYNSKI.

(Not given 1909-10).

Prerequisite: Mathematics 8a.

136. PROJECTVE DIFFERENTIAL GEOMETRY.—This course includes a brief account of Lie's theory with applications to the theory of invariants of systems of linear differential equations. The differential properties of plane and space curves, and of surfaces are considered from a projective point of view. This more general, projective standpoint distinguishes the course from the usual treatment of differential geometry, which is metric.. *Three time a week. I, II.* Associate Professor WILCZYNSKI.

Prerequisite: Mathematics 16, 27.

140. The Fundamental Concepts of Higher Mathematics. —A course dealing with general concepts of higher mathematics in their bearing on elementary mathematics. *Three times a week. I.* Assistant Professor Young.

Prerequisite: Senior standing in Mathematics.

(Not given 1909-10; to be given 1911-12.)

141. Vector Analysis.—A systematic exposition of the subject based upon the notations of Gibbs, followed by a comparative study of the various systems which have been proposed. *Three times a week. I, II.* Associate Professor Wilczynski.

Prerequisite: Mathematics 8b.

(Not given 1909-10).

Courses for Graduates and Advanced Undergraduates.

16. Differential Equations.—For students in the courses of engineering and of mathematics and of astronomy. It embraces the following topics: General linear equations with constant coefficients, special forms of differential equations of higher order, integration in series, etc. *Three times a week. I.* Professor Shattuck.

Prerequisite: Mathematics 8a, or 9.

17a. Advanced Calculus.—This course begins with the consideration of the fundamental notions and theorems of the calculus from a more advanced and critical point of view. This is followed by the study of certain more advanced topics in the integral calculus, inciuding ellipic integrals and functions defined by definite integrals. *Three times a week. II.* Assistant Professor Haskins.

Prerequisite: Mathematics 8a, 8b (or 7, 9.)

18a. Constructive Geometry.—The purpose of this course is primarily the development and training of the student's power of space perception. To this end the properties of lines, planes, and the simpler surfaces of the second order are studied by various methods of parallel and central projection. Special stress is laid on the graphical interpretation of the processes of analytic geometry and the analytic discussion of the methods of descriptive geometry. *Twice a week. I.* Dr. Sisam.

Prerequisite: Mathematics 6.

19a. Solid Analytical Geometry.—A general review of the

position of the plane and the right line in space and the more general properties of surfaces of the second degree. The classification and special properties of quadratics, and a brief introduction to the theory of surfaces in general. *Three times a week. II.*

Dr. CRATHORNE.

Prerequisite: Mathematics 8a (or 7), 10.

20. CALCULUS OF VARIATIONS.—This course has for its aim merely to acquaint the student with those elements of the science which are most needed in the study of the higher subjects of mathematical astronomy and physics. *Three times a week. II.*

Professor SHATTUCK.

Prerequisite: Mathematics 16.

21a. METHOD OF LEAST SQUARES.—The fundamental principles of the subject. The following subjects are studied: Law of probability and error, adjustment of observations, precision of observations, independent and conditional observations, etc. *Twice a week. I.* Assistant Professor STEBBINS.

Prerequisite: Mathematics 8a, or 7.

22a. PARTIAL DIFFERENTIAL EQUATIONS.—It deals with the integration and determination of the intergration constants of such partial differential equations as arise in the study of such subjects as the flow of heat, the vibration of strings, plates, etc., and electricity. *Twice a week. II.*

Professor TOWNSEND, Dr. CRATHORNE.

Prerequisite: Mathematics 8a or 9, 16.

23a. AVERAGES AND THE MATHEMATICS OF INVESTMENT.—The meaning, use, and abuse of different kinds of averages. The relation of the theory of probability to averages, and the application of the elements of probability to annuities, insurance, and various branches of science. Such information relating to loans and investments as can best be put into algebraic language, and are of interest to the general student. Many practical problems are given in the valuation of investment securities. *Three times a week. II.*

Assistant Professor RIETZ.

Prerequisite: Mathematics 2 and Junior standing.

24a. FUNCTIONS OF A COMPLEX VARIABLE.—A general introduction to the theory of functions of a complex variable. *Three times a week. I, II.* Professor TOWNSEND.

Prerequisite: Mathematics 8a, 8b, (or 7, 9), 10.

27. PROJECTIVE GEOMETRY AND LINEAR TRANSFORMATIONS.—

Sets of postulates for general projective geometry and the introduction of analytic methods on the basis of these assumptions. Projective transformations in the line, plane, and space. Introduction to the algebra of matrices and the theory of invariants. Subgroups of the general projective group. Euclidean, non-euclidean, and affine geometries. Theory of conics and quadric surfaces. Real and complex geometries. Throughout the emphasis is on geometric and algebraic interrelations. *Three times a week. I, II.*

Assistant Professor YOUNG, Dr. BÖRGER.

Prerequisite: Senior standing in Mathematics.

30. SEMINARY AND THESIS.—*Three times a week. I. II.*

Professor TOWNSEND, Professor MILLER, Associate Professor WILCZYNSKI, Assistant Professor RIETZ, Assistant Professor HASKINS, Assistant Professor YOUNG.

31. ACTUARIAL THEORY.—A detailed study of the application of probability to life contingencies, the construction and graduation of mortality tables, the elements of fire insurance and the calculation of premiums for various types of life and fire insurance. *Three times a week. I.* Assistant Professor REITZ.

Prerequisite: Mathematics 8a, and 29.

ASTRONOMY

Courses for Graduates

101. SEMINARY AND THESIS.—*Three times a week. I. II.*

ly individual. *Three times a week. II.* Assistant Professor STEBBINS.

Courses for Graduates and Advanced Undergraduates.

7. THEORETICAL ASTRONOMY.—This course begins with the elementary theory of the motions of the heavenly bodies, and is intended to lead the student up to the actual computation of a cometary orbit. *Three times a week. I, II.* Dr. REED.

9. CELESTICAL MECHANICS.—A continuation of course 7. Introduction to the theory of disturbed planetary motion. *I, II.*

Dr. REED.

14. OBSERVATIONAL ASTRONOMY.—This course is intended for those who wish to become familiar with the working methods of an astronomical observatory. The problems set for solution are largely individual. *Three times a week. II.*

Assistant Professor STEBBINS.

15. GEODETIC ASTRONOMY.—Advanced work with the sextant, transit, and zenith telescope. *Three times a week. I.*

Assistant Professor STEBBINS.

PHYSICS

The prerequisite for graduate work in physics is a university or college course in general physics with a year's laboratory course in introductory physical measurements. The student who is to do major work in physics should also have had additional courses in physics, or teaching experience, unless the training in his minor subjects, mathematics or chemistry, has been strong and complete. He should also have a knowledge of French and German sufficient to read reference articles in those languages. The courses named below are those open for candidates for the Master's and Doctor's degrees. A large part of the last year's work of the candidate for the Doctor's degree is investigational, along either the experimental or the theoretical side of physics. In addition to the following major courses for graduates, the "intermediate" courses on properties of matter, sound, heat, light, and electricity and magnetism (see University catalog Courses 14, 15, 16, 17,) may be offered by students making a minor in physics, and 14, 16, and 17 may with certain additions be arranged for major credit in physics.

Courses for Graduates

104. Electrical and Magnetic Measurements.—Laboratory exercises with discussions and recitations, giving a systematic course in exact electrical and magnetic measurements. *Two three-hour periods a week. I, II.*

Assistant Professor Knipp, Mr. Stifler, Mr. Stephenson.

120a. Light.—Lectures and recitations with class demonstrations of special phenomena. The modern theories are discussed and readings assigned in the texts of Drude, Wood, and Preston. *Two periods a week. II.* Assistant Professor Schultz.

120b. Light.—A laboratory course in light measurements selection experiments in dispersion, refraction, interference, polarization, etc. *Two to five periods a week for either semester.*

Professor Carman.

121. Recent Advances in Physical Science.—Lectures illustrated by experiments on the more recent developments of physics. The subject for the first semester will be Conduction of Elctricity through Gases, to be given by Dr. Knipp. The subject and lecturer for the second semester will be announced later. *Once a week. I, II.*

Professor Carman, Assistant Professors Knipp, Watson, Schulz, Kunz.

122. Thermodynamics.—Lectures and collateral reading on the principles and methods of thermodynamics. *Twice a week.. II.*
Associate Professor Goodenough.

123. Sound.—Lectures, recitations, and experiments on phenomena of sound. The course will include a consideration of the origin, propagation, velocity, and interference of sound, the vibration of strings, rods, and gas columns, and the physical theory of music and speech. Barton's Text-book of Sound will be used. *Twice a week. I.* Assistant Professor Watson.

124. Conduction of Electricity in Gases and Radio-activity. —A critical study both theoretical and experimental of recent investigations in this line. Text-books: Thompson's Discharge of Electricity through Gases, and Rutherford's Radio-Activity. Three *times a week.* Assistant Professor Knipp.

125. Heat.—Lectures and laboratory work involving for the coming year mostly theory and methods of the measurement of high temperatures by thermo-couples, resistance thermometers and optical pyrometers. *Twice a week. I, II.* Professor Carman.

126.—Journal Club.—A weekly meeting of the instructors and advanced students of the department to discuss assigned papers and topics.

127. Electron Theory.—Lectures and discussions on different phases of this subject. *Twice a week. I, II.*
Assistant Professor Kunz.

130a. Introduction to Theoretical Electricity.—A course of lectures and recitations discussing the phenomena with elementary calculus methods and with occasional lecture-room demonstrations. *Twice a week. I, II..* Assistant Professor Knipp.

130. Experiments in Electricity and Magnetism.—A course of electrical and magnetic measurements, supplementary to 104b, and including measurements in the field of the more recent discoveries, such as electrical waves, electrical discharges in gases, etc. *Two to five times a week. I, II.* Assistant Professor Knipp.

131. Investigation of Special Problems.—Advanced work in the laboratory or in design and calculation. A problem is chosen and worked with the advice and direction of the instructor. *One to five times a week. I, II.*

Professor Carman, Assistant Professors Knipp, Watson, Schultz, Kunz.

132. Mathematical Physics.—Lectures and recitations on special topics in theoretical physics. *Three times a week. I, II.*
Assistant Professor Kunz.

133. Seminary and Thesis.—
Professor Carman Assistant Professors Knipp, Watson, Schulz and Kunz.

CHEMISTRY

Graduate students whose major subject is in some other department than chemistry, before taking graduate work for credit in this department must have had the equivalent of 15 university credits in chemistry, and the work covered must have included satisfactory work in general chemistry and in qualitative and quantitative analysis. Such students are advised to take Chemistry 31, 33a, 102, 102a, 5b, 5c, or 14, 9a and 9b. Courses of a more special nature will not, as a rule, be accepted for graduate work unless preceded by one of the above courses.

For students in Agriculture 5a and 13a will not be accepted for graduate credits.

Graduate students who are candidates for an advanced degree in chemistry must have had the equivalent of 30 University credits in chemistry, and this must include satisfactory courses in general chemistry, qualitative and quantitative analysis, physical chemistry, and organic chemistry. Before receiving the degree of Doctor of Philosophy such students will be expected to complete work equivalent to courses 31, 33a (or 102 and 102a) 14, 9a, 9b, 101, and 111. They are advised to take at least brief courses in gas analysis, iron and steel analysis, water analysis, assaying, and chemical technology.

For students in chemistry, 5a, 13a, 9 and 9a will not be accepted for graduate credit and 9b, 9c, 14, 31 and 33a will be accepted only from students entering the Graduate School with the equivalent of 30 university credits in chemistry.

Courses for Graduates

101. History and Theories of Chemistry.—A discussion of the historical development of science of chemistry. *Twice a week. I.*
Dr. Smith.

102. Advanced Physical Chemistry.—This course will be conducted on the seminar plan and, together with 102a, is intended to over a period of two years. The subject is treated from the standpoint of Avogadro's Principle and Thermodynamics and the course

is based primarily upon Nernst's "Theoretische Chemie." The primary purpose of this course is to develop power to handle successfully a physico-chemical problem rather than merely to impart a knowledge of the phenomena and the principles involved. Text-books: *A. A. Noyes's General Principles of Physical Science; Nernst's Theoretische Chemie, 5th edition,* or the translation of the 4th edition. *Twice a week. I, II.* Dr. WASHBURN.

Prerequisite: Chemistry 1, 2 and Physics 1, 3. Mathematics 8a or 7 and 9. An elementary knowledge of organic and physical chemistry is desirable. A good reading knowledge of German will be found very helpful.

102a. ADVANCED PHYSICAL CHEMISTRY.—A continuation of course 102. The following topics will be considered in this part of the course: The physical properties of chemical substances, the Phase Rule, certain portions of thermochemistry, photochemistry, the thermodynamics of electrio-chemistry, radioactivity and the atomistic theory of electricity. This course alternates with course 102. Text books: *Nernst's Theoretische Chemie; Findlay's The Phase Rule and its Applications; Sbiles's The Relation between Chemical Constitution and Physical Properties. Twice a week. I, II.* Dr. WASHBURN.

Prerequisite: The same as course 102.

102b. ADVANCED ELECTROCHEMISTRY.—This course deals with the modern theories of solution and the principles of thermodynamics in their application to the problems of electrochemistry. The subjects of electrolytic conductivity and transference, electromotive force, and the energy principles underlying the transformations of chemical and electrical energy are discussed in detail. The recent advances in the electrolysis of fused electrolytes and the applications of electricity to gaseous reactions at high temperatures will also be dealt with. Text-book: *LeBlanc's Electrochemistry.* This course is also open to undergraduates having the necessary preparation. *Three times a week. II.* Dr. JONES.

Prerequisite: Chemistry 31 and 33a, Mathematics 8a or 7 and 9.

102c. ADVANCED PHYSICAL AND ELECTROCHEMISTRY.—A laboratory course dealing with the applications of physico-chemical methods to special problems. The nature of the experiments performed by the student will depend upon his previous training in this subject and his purpose in taking the course. The experiments are de-

signed to develop the power of independent thinking in applying physico-chemical methods to problems in the laboratory. This must be preceded or accompanied by course 102 or 102b. *Twice a week. II.* Dr. Washburn, Dr. Jones.

Prerequisite: Chemistry 31 and 33a. Mathematics 8a or 7 and 9.

103. Advanced Inorganic Chemistry.—A systematic presentation of descriptive inorganic chemistry, including the rarer elements and based on the periodic system. The work consists of two lectures a week throughout the year, which may or may not be accompanied by laboratory work on advanced inorganic preparations. *Two to five times a week. I, II.* Dr. Balke.

103a. Advanced Analytic Chemistry.—This course is designed for students who may desire to take advanced work in either qualitative or quantitative analysis. The lectures will deal with special topics in analytical chemistry. *One to five times a week. II.* Dr. Holmes.

104. Advanced Organic Chemistry.—Special chapters. This course consists of two lectures a week with assigned reading and is especially recommended to students doing research work in this subject. Special attention is given to the detailed study of recent research methods in such fields as: Condensation, carbohydrates, fermentation, and enzyme action, the purine group, the proteins, isomeric change, stereochemistry of nitrogen, color and chemical constitution, alkaloids, etc. The chapters may be varied from year to year. *Twice a week. I.* Assistant Professor Curtiss.

Prerequisite: Chemistry 9 or 14.

105. Advanced Physiological Chemistry.—This course consists of lectures, conferences, and demonstrations, and embraces selected portions of physiological chemistry which are not covered by Chemistry 15. The course is open to graduates or undergraduates. *Twice a week. II.* Professor Hawk.

Prerequisite: Chemistry 15.

106. Animal Chemistry.—A lecture course consisting of a critical study of the recent advances in the chemistry of nutrition of the lower animals, and a detailed study of the chemistry of the functional products, such as flesh, fat, milk, wool, etc., of the more common domesticated animals. *Twice a week. I, II.* Professor Grindley.

Prerequisite: Two years' work in chemistry.

107. Calorimetry of Fuels.—An advanced course in the study of methods for determining the heat values of solid, liquid, and gaseous fuels. *One to three times a week. I, II.* Professor Parr.

108. Water Supplies.—A study of the sources of contamination of water supplies and the purification of water for potable or technical use. *Five times a week. I, II.* Professor Bartow.

111. Thesis Work.—A thesis will usually be required of students taking the Master's degree and will always be required of students taking the degree of Doctor of Philosophy. As an illustration of the character of the work which may be done for these the following list of investigations now in progress in the department is given.

Physical Chemistry.—Dr. Washburn. A physicochemical study of aqueous solutions of caesium nitrate. Simplification of the cyclical process method for the derivation of thermodynamic equations. Dr. —. Heat of dilution of sugar solutions. Dr. Smith, Chemical equilibrium between amalgame and solutions.

Electrochemistry.—Determination of the electrochemical equivalent. Dr. Washburn.

Inorganic Chemistry.—Dr. Balke, Atomic weight of tantalum. Double fluorides of tantalum and columbium. Dr. Holmes, Interaction of hydrochloric acid and manganese dioxide. Peroxides and dioxides. Dr. Smith, Ammonium amalgams. Dr. Isham, Hydroxylamine compounds. Ferric acid. Dr. Jones, Atomic weight of phosphorus.

Analytical Chemistry.—Professor Grindley, A study of the precipitation of barium sulphate. Dr. Holmes, Analysis of silicates, Determination of cadmium in the presence of zinc. Separation of antimony and tin.

Organic Chemistry.—Professor Noyes, Molecular rearrangements in derivatives of camphoric acid. Assistant Professor Curtiss, Condensation Reactions of alcohols on mesoxalic esters. Derivatives of malonic ester containing nitrogen. Condensations in the 1, 2, 3 triketone series.

Sanitary Chemistry.—Professor Bartow, Action of coagulants on Lake Michigan water. Action of boiler compounds on water. Filtration and sterilization of river water.

111. Thesis Work.—Animal Chemistry.—Professor Grindley, and Messrs. Emmett and Gill. Improved methods for the anal-

ysis of animal substances. A study of the execretion of nitrogen in the form of nitrates. The chemistry of animal feces. A study of the effect of cold storage upon beef and poultry. The proteins of flesh. The chemical composition and nutritive value of the wholesale cuts of beef. A study of the methods for the determination of non-protein nitrogen in animal substances. The influence of the quantity, quality, and composition of the feeds of the lower animals upon the chemical composition and nutritive value of the resulting edible flesh. The determination of sulphur in animal substances. Animal Nutrition.

Physiological Chemistry.—Professor Hawk, A study of the excretion of the various forms of nitrogen as influenced by the diet. A study of the relation existing between urea and the total nitrogen content of the urine as influenced by variations in diet. Influence of fasting upon changes in the blood. The variation in the nitrogen partition in well-fed and fasting animals.

Industrial Chemistry.—Professor Parr, Weathering of coal. Changes in coal on heating to moderate temperature. Formation of calcium silicates at low temperatures. Mixtures of asphalt for technical purposes. Professor Bartow, Softening of water.

Courses for Graduates and Advanced Undergraduates

5c. Food Analysis.—This course includes the analysis of food stuffs, grain, milled products, alcoholic beverages, baking powders, vinegars, syrups, sugars, etc. Students who have taken work amounting to five hours' credit in this course may arrange to do more advanced work along the following lines: (a) the study of methods for detecting food adulterations; (b) the separation and determination of the nitrogenous constituents of animal and vegetable foods; (c) the identification and estimation of the carbohydrate constituents of food products. *Three to five times a week. II.* Dr. Holmes.

Prerequisite: Chemistry 5a or 13a, and 9 or 14.

6. Chemical Technology.—This is a course of lectures comprising a study of technological chemistry as illustrated in those industries having a chemical basis for their principal operations and processes. Much use is made of the journals. *Thorp's Industrial Chemistry* is used as a guide. No laboratory work. *Twice a week. II.* Professor Parr.

Prerequisite: Chemistry 5a.

7. Metallurgy.—A general course in metallurgical processes.

Lectures and assigned reading. *Twice a week. I.* Professor PARR.

Prerequisite: Chemistry 5a.

8. IRON AND STEEL ANALYSIS.—Analyses are made of all the constituents by both rapid or technical, and standard methods. *Three times a week. II.* Dr. HOLMES.

Prerequisite: Chemistry 5b.

9a. ORGANIC SYNTHESIS.—Laboratory work for students of the chemical course in ultimate organic analysis and the preparation and study of typical organic compounds, to accompany Chemistry 14. *Twice a week. I.* Assistant Professor CURTISS, Mr. DERICK.

Prerequisite: Chemistry 2 and 3.

9b. ORGANIC SYNTHESIS AND ANALYSIS.—Continuation of 9a, to accompany Chemistry 14. *Twice a week. II.*

Assistant Professor CURTISS, Mr. DERICK.

Prerequisite: Chemistry 9a.

10a. SANITARY ANALYSIS.—Lectures on history, sources, contamination, and standards of purity of potable waters and waters for industrial purposes, together with practice in analytical methods. *Twice a week. I.* Professor BARTOW.

13b. ADVANCED AGRICULTURAL ANALYSIS.—This course is offered to students who wish to specialize in agricultural chemistry or agricultural experimentation. The work includes the analysis of butter and cheese, the complete analysis of foods, soils, and plants, plant ash, rain and drain waters, and the determination of the fuel value of foods. If desirable, the work may be varied to meet the special needs of the individual student. *Three to five times a week. II.* Dr. HOLMES.

Prerequisite: Chemistry 5a or 13a.

14. ORGANIC CHEMISTRY.—This course consists of lectures and recitations upon the fundamental principles and more important compounds of organic chemistry. *Noyes's Organic Chemistry.* This course must be accompanied by Chemistry 9a and 9b. *Three times a week. I, II.* Professor NOYES.

Prerequisite: Chemistry 5a.

15. PHYSIOLOGICAL CHEMISTRY.—This course is designed especially for students desiring a fundamental knowledge of the principles of physiological chemistry. It will consist of lectures, demonstrations, conferences and practical work. The course will include a systematic study of enzymes; carbohydrates; salivary digestion, gastric digestion, fats, pancreatic digestion, intestinal di-

gestion, bile, putrefaction products, feces, blood, milk, epithelial and connective tissue, muscular tissue, nervous tissue and urine. The work on gastric juice, blood, urine, and milk will be both qualitative and quantitative, and all the clinical aspects of these topics will be treated thoroughly for the benefit of prospective students of medicine. The course is open to graduates and undergraduates. *Five times a week. I.* Professor HAWK.

Prerequisite: Two years' work in chemistry.

18. SPECIAL COURSES.—Special courses as indicated below, consisting mainly of laboratory work, may be arranged for those competent to pursue them. From 1 to 10 hours' credit will be allowed in the undergraduate courses for such work.

(a) Special problems in assaying and ore treatment. Free-milling chlorination and cyanide tests. Professor PARR.

(b) Advanced metallurgical chemistry. Professor PARR.

(c) Analysis and calorimetry of fuels. Professor PARR.

(d) Paints, oils, etc. Protective coverings for wood and iron. Professor PARR.

(e) Analysis of commercial fertilizers. Dr. HOLMES.

(f) Special methods of gas analysis. Professor PARR.

21. PROXIMATE ORGANIC ANALYSIS.—A course of laboratory practice, for advanced students, in systematic methods for the identification of organic compounds and a study of organic mixtures as found in commercial articles. *Twice a week. I.*

Assistant Professor CURTISS, Mr. DERICK.

Prerequisite: Chemistry 9b or 9c.

22. ANIMAL CHEMISTRY.—A course for the detailed study of the chemical composition of animal products and feeding stuffs. This is a combined classroom and laboratory course. *Three to five times a week. I or II.* Professor GRINDLEY.

Prerequisite: Two years' work in chemistry.

24. TOXICOLOGY.—Mainly laboratory work upon the detection and estimation of the more common poisons, organic and inorganic. *Twice a week. II.* Assistant Professor CURTISS, Mr. DERICK.

Prerequisite: Chemistry 5a and 9.

27. QUALITATIVE ANALYSIS OF THE RARE ELEMENTS.—A detailed study of the rare elements and their compounds. The work consists mainly in the identification and separation of the elements and the study of the formation, solubilities, and chemical reactions of

their salts. Reading is assigned in connection with laboratory work. *Three times a week. II.* Dr. BALKE.

Prerequisite: Two years' work in Chemistry.

31. ELEMENTARY PHYSICAL CHEMISTRY.—This course is designed to present, in an elementary manner, some of the more important principles and methods of physical chemistry and electrochemistry. Instruction is by lectures and recitations. To secure familiarity in applying the laws and principles of physical chemistry to practical problems in other branches of chemistry, the student is expected to solve numerous problems in connection with this course. *Walker's Introduction to Physical Chemistry. Three times a week. II.* Dr. WASHBURN.

Prerequisite: Chemistry 1, 2, and 3; Physics 1 or 2a.

33a. ELEMENTARY PHYSICAL CHEMISTRY.—A laboratory course to accompany course 31. The experiments performed will include, the methods of determining molecular weight both in the gaseous state and in solution; the application of the principles relating to chemical equilibrium; the measurement of the electrical conductivity of solutions and the application of this property in interpreting the phenomena occurring within the solution; and the illustration of some of the fundamental conceptions of thermochemistry. *Twice a week. II.* Dr. WASHBURN, Dr. JONES.

Prerequisite: Chemistry 5a, Physics 2b or 3.

34. ELECTROCHEMISTRY.—A series of lectures and conferences to accompany course 35. *Blount's Practical Electrochemistry,* and *Perkins's Practical Methods of Electrochemistry.* See also Chemistry 102b. *Once a week. I.* Dr. JONES.

Prerequisite: Chemistry 31.

35. ELECTROCHEMISTRY.—A laboratory course dealing with the practical applications of electrochemistry in the industries. Intended for students going into technical work and for engineers. This course will deal with the electrodeposition and refining of metals both in aqueous and igneous solution, electrolytic preparation of inorganic and organic substances, the principles of electroplating, and the products of the electric furnace, such as the preparation of carbides, carborundum, aluminum, calcium, and the reduction of refractory ores. *Two to five times a week. I.* Dr. JONES.

Prerequisite: Chemistry 33a.

61. INORGANIC PREPARATIONS.—A laboratory course in the preparation of chemical products from raw materials. The manufacture

and testing of pure chemicals, fractionation, and other processes of the manufacturing chemist. *Twice a week. II.*

Professor PARR, Dr. MEARS.

Prerequisite: Chemistry 5a.

65. TECHNICAL GAS AND FUEL ANALYSIS.—Examination of gases, gas mixtures, flue gases, and fuels. Determination of calorific values and calculation of efficiencies. *Twice a week. I.*

Professor PARR, Dr. MEARS.

Prerequisite: Chemistry 5b.

66. EXACT GAS ANALYSIS.—A laboratory and lecture course on the analysis of commonly occurring gaseous mixtures, involving the use of the Hempel apparatus, measuring gases under constant pressure and constant volume and determination of the density of gases. *Twice a week. II.* Dr. ISHAM.

Prerequisite: Chemistry 5b.

68a. ANALYSIS OF GLASSES AND GLAZES.—For students in ceramics. A study of methods and practice on special problems connected with the pottery industry. *Three times a week. I.* Dr. HOLMES.

Prerequisite: Chemistry 5b.

68b. CEMENT CHEMISTRY.—For students in ceramic engineering. This course includes the analysis of cements, cement materials, pottery bodies, etc. *Three times a week. I.* Dr. HOLMES.

Prerequisite: Chemistry 5b.

69. ASSAYING.—The fire assay of lead, gold, and silver ores. Fluxes, reagents, and charges are studied in connection with various typical ores, and practice given in use of the crucible and muffle furnaces and in the manipulations connected with fire assaying *Twice a week. I.* Professor PARR, Dr. MEARS.

Prerequisite: Chemistry 5a. Mineralogy.

93. JOURNAL MEETING.—For juniors, seniors, and graduates. *Once a week. I, II.* All members of the teaching staff in the Chemical Department.

GEOLOGY

Courses for Graduates

102. PETROGRAPHY.—Lectures and laboratory work on the igneous rocks including identification of types, classification, and relationships. *I; two hours daily.*

Associate Professor BAYLEY.

103. Petrography.—A continuation of course in which schists and sedimentary rocks become the objects of study. *II; Two hours daily.* Associate Professor Bayley.

105. Stratigraphic Paleontology.—A course devoted to the study of the literature and the fossils of a special geological system; their geographic distribution; the geologic provinces; and the origin and the routes of migration of the different faunas during the period. Largely individual work. Assistant Professor Savage.

106. Field and Laboratory Course.—A course consisting of a systematic study of a selected area in Jackson and Union counties, Illinois. A carefully prepared report on the geology of the region, based on the data collected in the field, is required. Assistant Professor Savage.

Courses for Graduates and Advanced Undergraduates

6. Physical and Optical Mineralogy.—A direct introduction to the course in Petrography. The physical and optical properties of minerals are discussed in lectures and studied in the laboratory, with special reference to their relations with respect to symmetry. The larger portion of the work is devoted to the study of polarized light and its practical use in identifying the rock-form materials. *II; two hours daily.* Associate Professor Bayley.

7. Petrography.—The principles learned in Course 6 are applied to the study of rocks. Lectures describe the different types of these rocks and discuss their origin and classification. In the laboratory a representative suite of specimens is studied in the hand specimen and thin section. *I; two hours daily.* Associate Professor Bayley.

9. Paleontology.—A study of invertebrate fossils, their classification and relationships, their succession in the rocks, and their geographic distribution. Instruction is given in the identification of the fossils, and in the finding and use of the literature of the subject. *I; two hours daily.* Dr. Bagg.

16. Stratigraphy.—This course follows Course 9, and is a study of principles of classification and nomenclature of rock formations, of the methods and criteria employed in correlation, of the characteristic faunas and floras of the successive geologic formations and their distribution, and of the relation of these to the interpretation of stratigraphy. Lectures and laboratory. *II; two hours daily.* Assistant Professor Savage.

17. Stratigraphic Geology.—A study of the distribution of the strata of the successive geological systems, the character of the sediments which compose them, and the interpretation of these deposits and their distribution in their relation to paleo-geography. *II; one hour daily.* Assistant Professor Savage.

19. Field Geology.—Introductory Course.—A field course of two weeks will be taken as a course introductory to the study of Stratigraphy, Paleontology, and Physiography.

Ceramics

Courses for Graduates

The subject of silicates and the silicate industries offers a unique field for research, since there is probably no other field of technology which needs so much the plow and harrow of the investigator. The problems to be solved are practically unlimited in number, and some branches represent indeed a terra incognita.

Ceramics 101.—The theoretical principles underlying the formation of silicates are considered from the modern standpoint, involving the conceptions of physical chemistry. Lectures and laboratory work. *Five times a week. I.*

Ceramics 102.— Special problems relating to the technology of the clay industries. Some of the topics which may be selected are: Mineralogical constitution of clays, plasticity and the collodial state, absorption, pyro-chemical and physical changes, exothermic and endothermic processes, the crystalline and amorphous state of burnt clay, thermal expansion of bodies and glazes, bodies and their interaction with glazes, the composition and constitution of glazes, dissolved and underglaze colors, translucency and opacity, the colors of rare oxides in glazes, eutectic studies, reduction and oxidation phenomena, heat radiation and conduction. *Five times a week. I, II.*

Ceramics.—Special problems relating to the technology of the cement and mortar industries. Topics: Fusion curves of lime, lime-iron, lime-alumina, and lime-iron-alumina silicates, the action of catalyzers, crystallization of basic silicates, constitution of cement compounds, hydration and dehydration, thermal studies, etc. *Five times a week. I, II.*

Ceramics 104.—Problems relating to the technology of glass. Topics: Fusion curves of glass silicates, limiting compositions, solubility of the oxides in glasses, devitrification, annealing, optical

properties, solubility of glasses, viscosity, thermal expansion, pyrochemical volume changes, etc. *Five times a week. I,II.*

E—The Biological Sciences

BOTANY

Courses for Graduates

101. Cytology.—The influence of external agents on the cell. Special subjects for investigation are assigned upon consultation. Reports and discussions of current literature and research results. *I. II.* Assistant Professor Hottes.

102. Physiology.—The effects of external stimuli on growth and movement. Special subjects for investigation are assigned upon consultation. Reports and discussions of current literature and research results. *I, II.* Assistant Professor Hottes.

103. Bacteriology.—Investigations upon morphologic and physiologic variation due to treatment; systematic studies upon the number, validity, and relationship of species, researches upon special saprophytic or parasitic kinds of bacteria and upon methods of favoring or combating their activities. *I, II.* Professor Burrill.

104. Bacteriology.—Special methods, intended to develop technical skill introductory to research upon pathogenic bacteria. *II* Dr. MacNeal.

105. Bacteriology.—Investigations upon micro-organisms related to the animal body in health and disease. *I, II.* Dr. MacNeal.

106. Vegetable Pathology.—Diseases of plants and disease agents. *I, II.* Professor Burrill.

107. Ecology and Phytogeography.—Investigations upon plant associations and phytogeographic relations of selected areas, based on approved field work. *I, II.* Dr. Gleason.

Courses for Graduates and Advanced Undergraduates

After at least one year of approved botanical work and the further prerequisites, graduates may elect any of the courses 3, 5, 7, 8, 9, 10, 16, 18, and 19, or 20 for minor credit; and any of courses 3, 7, 8, 9, or 18 and 19, with assigned additions for major credit.

3. Cytology and Physiology.—The first semester is devoted mainly to cytology and histology, with special attention to technique; the second, to a study of the influences of external stimuli on growth and movement. *Five times a week. I, II.*

Assistant Professor Hottes.

5. Bacteriology.—General principles of the science, methods of procedure, and a study of selected forms. Lectures, recitations, and laboratory work. *Five times a week. I, II.*

Professor Burrill, Mr. Briscoe.

7. Plant Pathology.—A study of the principal groups of parasitic fungi and plant diseases due to them, with methods of investigation and control. *Five times a week. I, II.*

Professor Burrill.

8. Bacteriology.—A detailed study of selected species of bacteria or investigations upon assigned subjects. *Two to five times a week, I, or II.* Professor Burrill.

9. Cytology and Physiology, Advanced Course.—Special laboratory problems in certain phases of cytology and physiology. *Two times a week. I, II.* Assistant Professor Hottes.

10. Seminary.—Reports and discussions upon assigned topics and results of research work. *Once a week. I, II.*

Professor Burrill.

16. Taxonomy of Special Groups.—Mostly laboratory and herbarium work, and assigned reading. *Five times a week. I, II.*

Dr. Gleason.

18. Ecology.—Field and laboratory studies of selected areas, with assigned reading and lectures. The field work must be done wholly or in part during the preceding summer on an area approved by the instructor. *Two to five times a week. I, II.* Dr. Gleason.

19. Seminary in Ecology.—Reports and critical discussions of current literature and research work. For graduate credit must be taken with or after course 18. *Once a week. I, II.* Dr. Gleason.

20. Ecology and Taxonomy.—Special problems upon individual assignments, dealing mainly with the plants of Illinois and vicinity. *Two to five times a week. I, II.* Dr. Gleason.

HOUSEHOLD SCIENCE

101. Home Economics.—A study of the origin and development of home economics, with particular reference to its industrial, educational, and sociological aspects. Professor Bevier.

102. Special Investigations.—Problems in the application of the principles of bacteriology, chemistry, and physiology, to the ordinary processes used in the preparation of food. Professor Bevier.

Courses for Graduates and Advanced Undergraduates

4. Food and Nutrition.—An application of the principles of pure science to the problems of food and nutrition. The problems may be physiological, chemical or bacteriological. *I;* (5).

Professor Bevier, Assistant Professor Usher.

5. Dietetics.—The work in dietetics includes the following topics: The principles of diet, the relation of food to health; influence of age, sex, and occupation on diet; the construction of dietaries; dietetic treatment of certain diseases; principles of home nursing. *II;* (3). Assistant Professor Usher.

PHYSIOLOGY

101. Physiological Journal Club.—This club is composed of the teaching staff of the department and the graduate students. Recent articles of interest in current journals will be reported and discussed. Each student reports a paper about once in two months.

Assistant Professor McClellan.

103. Original Research.—Every facility and encouragement, so far as the resources of the laboratory and library permit, are offered to those prepared to avail themselves of these researches as part of the work for the master's or doctor's degree, or for carrying on original work for publication.

Assistant Professor McClellan.

1. Major Course.—This course is designed for medical students whose previous training has given them a broad foundation in physics, chemistry, zoology and embryology. It embraces three lines of work, viz, histology (microscopic anatomy), physiological chemistry and physiology proper. It begins with a comprehensive study of the microscopic structure of the tissues in general, and later includes the structure of the organs in particular with relation to their functions. This course gives the student a year's experience in technique and in the indentification of tissues under the microscope, and fits him especially to profit by advanced work in pathology,—both general and surgical. The part of the field which is common to physiology and to physiological chemistry is covered, as far as possible, in the first semester and a number of lectures are added to supplement the course which the student has already taken in organic chemistry (9 and 9c), thus making a course in physiological chemistry which is fairly complete. For the sake of

laboratory work this course should be rounded out when possible, by elective work in physiology 2 or 7. The work in physiology proper runs throughout the year. The wide scope of the course, as a whole, makes it impossible to cover the entire field, and give the proper amount of time for laboratory work. For this reason the physiology of the brain and of the special senses is not treated fully. These subjects are studied in advanced courses in the medical school, and the student can take them in their proper place. The course is accompanied with many demonstrations, but for the benefit of the student these cannot take the place of personal experiments. For this reason it is urgently recommended that physiology 2 be elected when possible. *Five times a week. I, II.*

Assistant Professor McClellan, Dr. Stanley.

2. Advanced Course.—This course is supplementary to physiology, and can best be taken the year after physiology 1 is completed, but may also be taken parallel with physiology 1 by arrangement with the head of the department. The experiments are conducted mostly by the students working in small groups, and conferences on the results of such experiments are held from time to time under the direction of the instructor. Towards the end of the first semester about two hours a day for six weeks are devoted to urine-analysis. The work in this course gives considerable experience in operative surgery, in the methods employed in studying the action of drugs, and in the use of apparatus for the finest kinds of clinical diagnosis. *Five times a week. I, II.*

Assistant Professor McClellen, Dr. Stanley.

5. Special Physiology.—This course is given to meet an emergency, which sometimes arises, where a student wishes to take up a special line of work not specified in one or the other courses, and not involving the preparation of a thesis. At the discretion of the head of the department students may register for such work. Arrange details with the instructor.

7. Physiological Chemistry.—For students who have not the time, or who can not fulfill all the requirements, for physiology 1 and 2. It consists of lectures given in physiology 1, and laboratory work given in physiology 2, and includes urine-analysis. Students taking this course must be prepared to be present daily, the fourth hour, with physiology 1. When the class is engaged on non-chemical work the students in 7 will be excused. The laboratory hour

must be in the afternoon while the class in physiology 2 is covering the same ground. During the months of December and January, the students must be able to arrange one hour daily in common with physiology 2. *I, II.* Assistant Professor McCLELLAN, Dr. STANLEY.

8. HISTOLOGY.—This is the histological part of Physiology 1. It may be taken by those who can not meet the requirements for that course. Students who register in 8 must be present daily with physiology 1 at the third hour, and, when demonstrations are given which last for two hours, they will be expected to remain during the fourth hour also. When Physiology 1 is engaged on other work, during the third hour, the students in 8 will be excused. *I, II.*

Assistant Professor McCLELLAN.

ZOOLOGY

Courses for Graudates

103. GENERAL EMBRYOLOGY.—Lectures, conferences, and laboratory work. The lectures deal with general embryological topics in advance of those treated in zoology 3, including the history of the germ cells, maturation and fertilization, theories of development and inheritance, and recent experimental researches in the mechanics of development and the correlative differentiation of organs. The laboratory work consists of a study of the early development of invertebrate types. *II; Lectures 2 hours weekly; laboratory* 8 *hours weekly.* Dr. CARPENTER.

115. VARIATION AND HEREDITY.—A course which includes lectures on the methods and results of recent investigations in the study of variation and heredity, with assigned problems requiring individual work on some phase of the subject. *I.*

Associate Professor SMITH.

117. FAUNISTIC ZOOLOGY.—Problems in taxonomy, distribution, and ecology, accompanied by field work, conferences, and lecures. The department is especially favored in the work of this course by the fact that a natural history survey of the state is in progress at the University, and that students have the advantage of the collecions, library, apparatus, and operations of this survey as an aid to their personal studies. Unusual opportunities are given for a study of the species, distribution, habits, and ecology of the mammals, birds, and fishes of this state. See also Entomology 103. *Three to five times a week. I, II.* Associate Professor SMITH, Dr. ADAMS.

119. PHYSIOLOGICAL ZOOLOGY.—Conferences, study of literature,

and laboratory investigation on one of the following topics: (a) the general physiological relations between the tissue cell or the free living cell and its liquid medium: The application of the theories of crystalloidal and colloidal solution to biologocal problems of a general character, such as osmosis, cell metabolism, and the biochemical aspects of cellular activity; (b) the physiology of the Protozoa, including the conditions of their nutrition and division, the action of chemical and physical stimuli upon their motor and nutritive functions, and the relation of these organisms to sanitary and pathological problems. *Five times a week.*

121. Individual Research Courses.—

(a). Systematic Zoology. Associate Professor Smith.

(b). Faunistic and Ecological Zoology. Dr. Adams.

(c). Vertebrate and Invertebrate Embryology. Dr. Carpenter.

(d). Structure and Development of the Nervous System.—Animal behavior. Dr. Carpenter.

Courses for Graduates and Advanced Undergraduates

After at least one year of approved zoological work, together with the prerequisites for the several courses, graduate students may elect courses 3, 9, 11, 17a, 17c, 19, and 20 for minor credit, and courses 4, 15, 15a, 18, 19, and 20 for major credit.

3. Vertebrate Embryology.—This course begins with a study of the sex cells, fertilization, and the early stages in the development of the egg. The laboratory work includes the preparation of embryological material and the study of serial sections of chick and pig embryos. *Three times a week. I, II.* Dr. Carpenter.

4. Zoological Theory.—Lectures and assigned readings on the facts, problems, and theories of evolution and devolpment, and the related topics of variation, heredity, and selection. *Three times a week. II.* Associate Professor Smith, Dr. Folsom.

7. The Structure and Functions of the Vertebrate Nervous System.—Lectures and laboratory work on the structure of the vertebrate nervous system, including a study of the grouping and chaining of the neurones to form central and peripheral nervous organs, of the nervous impulse, of the stimulation of the sense organs, and of various reflex actions. *Three times a week. II.*

Dr. Carpenter.

9. Zoological Ecology.—This course is intended as an introduction to the study of the relation of animals to their natural environment as illustrated by the local fauna. Field trips are made for a

study of the animals and the conditions under which they live, and for instruction in methods of observation and the making of notes and collections. In the laboratory the specimens collected are observed and determined, reports are prepared, and a working knowledge of the literature is acquired. Principal attention is given to insects, mollusks, reptiles, amphibians, and fishes. *Five times a week. II.* Arrange hours. Dr. ADAMS.

11. PRINCIPLES OF ZOOGEOGRAPHY.—An introduction to the study of the geographic distribution of animals, in which particular attention is given to the funas of North America and to the State of Illinois. The fauna is considered in its relation to the complete ecologic environment—climate, physiography, geology, vegetation, etc.—and from the standpoint of its origin and its dynamic relations. This course should be of special value to students and teachers of biology, geography, geology, and commercial geography. It consists of lectures, laboratory work on maps, and field excursions, two or three lectures a week. Saturday excursions, to be arranged. *Three to five times a week. II.* Dr. ADAMS.

15. VARIATION AND HEREDITY.—A course of lectures and reference reading designed to give a general survey of the results obtained by the application of modern methods in the study of variation and heredity. For accompanying laboratory work see 15a. *Twice a week. I.* Associate Professor SMITH.

15a. STATISTICAL DATA.—Laboratory work involving the collection of data suitable for a study of the variations and correlations of structure in some suitable organism may be elected in connection with course 15. The extensive collections of insects, fishes and plankton material in the possession of the State Laboratory of Natural History are available for the purpose of this course. *One to three times a week. I, II.* Associate Professor SMITH.

17a. FIELD ZOOLOGY.—A course in which the main object is to gain as comprehensive a knowledge as practicable of the animal life of a restricted locality. Collection, preservation, and identification, of various kinds of animals, together with observations of the habits, life histories, and relations to environments of selected forms, constitutes the major part of the work. *Three times a week I.* Associate Professor SMITH.

17c. ADVANCED FIELD ZOOLOGY.—This course is a continuation of 17a, and provides an opportunity for more intensive work on more restricted problems in connection with the local fauna. *Three to five times a week. II.* Associate Professor SMITH.

18. Microscopic Organisms.—This course has for its object matter the minute aquatic life of fresh water with special reference to those organisms which have a relation to sanitary problems. The first part of the course is occupied with the identification, collection, numerical estimation, and the life history and interrelation of these forms. Selected examples are then studied under experimental conditions with special reference to sanitation. *Five times a week. I.*

19. Physiological Zoology.—This course deals with the general principles of animal physiology as illustrated by the zoological groups. *Three times a week. I, II.*

20. Current Literature.—The instructors and advanced students of the department meet at stated intervals as a journal club for the presentation and discussion of the results of research.

Assistant Professor Folsom and Dr. Carpenter.

ENTOMOLOGY

Courses for Graduates

, 103. Faunistic Entomology.—Entomological studies parallel to those of course 117 in zoology. The operations of the office of the State Entomologist and of the State Laboratory of Natural History, both closely affiliated with the department, give exceptional opportunities to students of this course. *I, II. (Daily).*

Professor Forbes and Assistant Professor Folsom.

108. Individual Research Course.—Morphological, systematic, and ecological entomology. Assistant Professor Folsom.

Courses for Graduates and Advanced Undergraduates

2. General Entomology.—This course and entomology 3 form a year's connected major work in entomology, covering substantially the whole field. The present course is devoted mainly to field entomology in the fall and later to the morphological and physiological aspects of the subject. Beginning with the collection and preservation of specimens and the making of field observations, it is continued by laboratory studies of typical insects, made with special reference to the recognition of adaptive structures, and experimental work intended to determine their exact utilities. *Five times a week. I.* Assistant Professor Folsom.

3. General Entomology.—To be taken either with or without the preceding course. The classification and determination of in-

sects, the study of life histories in the insectary and by field observation, and the collection of information with respect to the ecological relations of insects, are the principal objects of this course. *Five times a week.* Assistant Professor FOLSOM.

5. ADVANCED ENTOMOLOGY.—Under this head students desiring advanced work in entomology, especially as a preparation for thesis work in this subject, will be individually provided for on consultation with the entomological instructors. The course may be made to cover one or two semesters and to earn a three-hour or a five-hour credit in each. At least a three-hour course for one semester will be required as a preparation for entomological thesis work. *Three to five times a week, I, II.*

Professor FORBES, or Assistant Professor FOLSOM.

7. SYSTEMATIC ENTOMOLOGY.—This course, while primarily entomological, is designed to be of general use to students of biology. The lectures include a historical and critical survey of the systems of classification; a discussion of the aims and methods of classification; the nature of species, genera, and other groups, and the rules of nomenclature; the preparation of taxonomic articles, involving the study of bibliography, synonymy, analytical keys, etc. These subjects receive practical treatment in the laboratory, and to qualified students the unworked material of the State Laboratory of Natural History is available for study. *Three times a week. I, II.* Assistant Professor FOLSOM.

8. ADVANCED ECONOMIC ENTOMOLOGY.—A course of lectures, recitations, and field and laboratory work intended to prepare students for service as economic entomologists in state and government positions. Agronomy 7 and Horticulture 1, 2, and 3 should also be taken as a part of this preparation. *Three times a week. I, II.* Professor FORBES and Assistant Professor FOLSOM.

F—Engineering

ARCHITECTURE

Courses for Graduates

101. ARCHITECTURAL CONSTRUCTION.—This may include a study of large wooden buildings, the uses of stone and certain ceramic products in building, steel frame buildings, fireproofing buildings,

slow-burning buildings, or of plain and reinforced concrete buildings, or of a combination of these.

102. The Sanitation of Buildings.—This may include the arrangement of public buildings with reference to sanitation, systems of heating and of ventilation, or of systems of electric wiring and lighting, or of a combination of these.

103. Architectural Drawings.—This may include advanced graphic statics, stereotomy, advanced perspective, or advanced water color painting, or a combination of these.

104. Architectural Design.—This may include a study with practice covering the evolution of architectural styles, advanced architectural design, applied esthetics or of industrial design, or of a combination of these.

105. Architectural Practice.—This may include the translation of some selected architectural book, indexing and classification of data, architectural photography, methods of reproducing drawings and specifications, preparation of specifications and estimates for large buildings, office arrangement and methods, or a combination of these.

CIVIL ENGINEERING

Courses for Graduates

107. Bridge Design.—The determination of the stresses in swing, cantilever, and suspension bridges; and a study of structural details, of shop equipment, and of methods of fabrication. This work may require an inspection of, and report upon, bridge shops or of work in progress...*I* or *II*. Assistant Professor Dufour.

110. Metallic Building Construction.—The design of the metal skeleton of buildings for various purposes. The work is taught by means of lectures, problems, and inspection of construction work in progress. *Three to five times a week. I or II.*
Assistant Professor Malcolm.

115. Reinforced Concrete Design.—A study of the materials, the design, the forms, and the erection of reinforced-concrete structures. *I or II.* Associate Professor Brooks.

120. General Engineering Experience.—Under this head may be considered the practical experience of graduates of the University of Illinois in actual engineering work, who are candidates for a

professional engineering degree, provided before the work is begun the head of the department agrees to consider such work with a view to counting it toward an advanced degree. To obtain credit for such experience the student may be required to submit reports, designs, etc., or may be required to take an examination.

Professor BAKER.

ELECTRICAL ENGINEERING

Courses for Graduates

101. THEORY OF ALTERNATING CURRENTS.—This includes a study of polyphase circuits, alternating current machinery, alternating current measuring apparatus, or a combination of these subjects.

Professor BROOKS.

102. THE GENERATION, TRANSMISSION, AND UTILIZATION OF ELECTRICAL ENERGY.—This includes a study of dynamo-electric machinery, light and power plants, switchboards, transmission lines, motor driving, electrometallurgy, or a combination of these subjects. Assistant Professor PAINE.

103. ELECTRICAL DESIGN.—This includes the development of plans for an electrical machine or apparatus of specified character, or for the arrangement of an electrical plant, or for the installation of such machinery or apparatus. Assitant Professor WALDO.

104. ELECTRICAL ENGINEERING RESEARCH.—*This includes tests* of electrical apparatus or the experimental investigation of some electrical problem. Mr. BRYANT.

MECHANICAL ENGINEERING

Courses for Graduates

102. MODERN SHOP METHODS AND MANAGEMENT.—This course includes a study of modern methods of construction; special tools and processes; cost keeping; payment of labor, and kindred topics. Lectures on organization and management are given. *Twice a week. I, II.* Assistant Professor GILL.

105. KINEMATICS AND GRAPHIC KINETICS.—The kinematic and kinetic problems connected with typical mechanisms are analyzed and studied. Graphical methods are for the most part employed. The following is an outline of topics: —Construction of velocity and acceleration polygons; the law of Coriolis and its applications; kine-

tics of steam engine and quick return motions; analysis of engine governors. *Three times a week. II.* Mr. DIRKS.

106. HEAT MOTORS AND REFRIGERATING MACHINERY.—Special emphasis is laid on the advanced theory of the internal combustion motor, and of the steam turbine. The general principles and methods of refrigeration are studied. *Three times a week. II.*

Associate Professor GOODENOUGH.

107. THERMODYNAMICS.—The general principles of thermodynamics are developed and applied to the solution of various physical and chemical problems. *Twice a week. I.*

Associate Professor GOODENOUGH.

109. MACHINE DESIGN.—Individual problems are assigned so that the student may specialize along the line of his inclination. The course also includes the general theory of rational design and the application of Mechanics of Materials to design. *Three times a week. I, II.* Assistant Professor LEUTWILER.

112. LABORATORY INVESTIGATIONS.—This course consists of special invesigations of problems relating to combustion of fuel, boiler economy, steam engines and turbines, gas engines and producers, properties of explosive mixtures, mechanical refrigeration, etc. Emphasis is laid upon original work. *Three times a week. I, II.*

Assistant Professor THORPE.

114. ENGINEERING DESIGN.—The student is required to make a design with estimates and specifications of a complete engineering project, such as a manufacturing plant, a power plant, or a pumping station. *Three times a week. I, II.*

Assistant Professors THORPE and LEUTWILER.

MECHANICS, THEORETICAL AND APPLIED

Courses for Graduates

101. ANALYTICAL MECHANICS.—This is an extension of the undergraduate course. The foundations of mechanics and its various relations, the methods of treatment and attack, and the study of the more complex problems and applications are taken up. A critical and comparative study of texts is also made.

102. RESISTANCE OF MATERIALS.—Advanced work on the properties of materials used in engineering construction and the methods of determining these properties; analysis and investigation in mechanics of materals, including the effect of form of member in

a structure or machine and the method of application of forces. Comparative study of texts may be made.

103. Hydraulics and Hydraulic Engineering.—The laws of hydraulics and their application to engineering problems; hydraulic power and its development; design and investigation.

104. Experimental Work in Laboratory of Applied Mechanics.—(a) Laboratory investigation in the materials testing laboratory on materials and on their action as used in machines and structures; (b) experimental work in the hydraulic laboratory with pumps, motors, and measuring devices, and the investigation of the laws of hydraulics, the development of power, and the study of various hydraulic problems.

105. Experimental and Analytical Work in Reinforced Concrete.—Research work in reinforced concrete and the study of its application to structures.

MUNICIPAL AND SANITARY ENGINEERING

Courses for Graduates

102. Water Supply Engineering.—Advanced work in water supply engineering will be arranged to fit the conditions of individual classes. Sources and requirements of water supply, general water works construction, pumps and pumping, design of reservoirs and elevated tanks, and water works operation and the valuation of plants are among the topics which may be treated.

103. Sewerage.—General sewerage design and construction, a study of sewerage systems, hydraulics of sewers, and a study of run-off are examples of the work which may be taken up.

106.—Water Purification, Sewage Disposal and General Sanitation.—The design, construction, and operation of water purification plants and of sewage disposal works, the study of existing plants, comparison of results and cost of construction and operation may be taken up in this course. Experimental work on water filters, septic tanks, etc., may be included. Garbage disposal and general sanitation may also be taken.

RAILWAY ENGINEERING

Courses for Graduates

102. Locomotive Design.—Study and analysis of modern practice concerning steam pressure, compounding, superheating, etc.

The work in this course may be arranged to suit special requirements of the individual student. Professor Goss.

106. Locomotive Operation.—Study and determination of train resistance and locomotive tractive effort. The application of these and other matters in the establishment of tonnage ratings. Associate Professor Schmidt.

108. Electric Railway Practice.—This course deals with the design, selection, operation, and maintenance of electric railway equipment. Central station, sub-station, rolling stock, and line equipment are considered. The emphasis is put upon either design or operation according to the training and purpose of the student. Mr. Wenger.

110. Railway Location.—This course is essentially a study of the effects of the location of a railway upon its earning capacity. It deals with the engineering and economic problems met with in original location, as well as in the relocation and reduction of grades of existing lines. Assistant Professor Roberts.

Courses for Graduates and Advanced Undergraduates

1. Locomotives.—This is an introductory course and includes a study of the mechanics of the locomotive and some problems relating to its operation. In it are considered the engine and valve mechanisms, counterbalancing, the determination of tractive effort, tonnage rating problems, and the development of types. *Twice a week. I.* Associate Professor Schmidt.

4. Locomotive Performance.—A study of locomotive boiler and engine performance. This includes the consideration of the influence upon performance of such factors as combustion rate, steam pressure, speed, cut-off and other valve relations, compounding and superheating. *Twice a week. I.* Mr. Williamson.

7. Advanced Design.—Advanced problems in locomotive and car design and shop arrangement. This is a continuation of the work in course 2. *Three times a week. II.* Mr. Williamson.

31. Railway Yards and Terminals.—Instruction is given in the methods of proper location of yard tracks to insure efficiency of operation. The course includes a consideration of the details of track construction as well as that of the general question of yard design. *Three times a week. II.* Assistant Professor Roberts.

64. Electric Railway Practice.—This course forms with course 65 a series, in which are studied the engineering problems

which, in electric railway practice, present themselves in preliminary road location; in the selection of rolling stock and rolling stock equipment; and in the operation and maintenance of central stations, substations and distributing systems. *Three times a week. I.*

Mr. WENGER.

65. ELECTRIC RAILWAY PRACTICE.—This is a continuation of course 64. In addition to the matter there indicated it includes a consideration of the problem of steam road electrification. *Three times a week. II.* Mr. WENGER.

G—Agriculture

AGRONOMY

Courses for Graduates

101. SYSTEMS OF SOIL INVESTIGATION; SOURCES OF ERROR AND METHOD OF CONTROL, INTERPRETATION OF RESULTS.

Professor HOPKINS.

102. THE WORLD'S SUPPLY OF PLANT FOOD MATERIALS, IN-THEIR ULTIMATE EFFECTS UPON THE SOIL. Professor HOPKINS.

103. DIFFERENT SYSTEMS OF AGRICULTURAL PRACTICE AND THEIR ULTIMATE EFFECT UPON THE SOIL. Professor HOPKINS.

104. DRAINAGE WATERS; SURFACE AND SUB-DRAINAGE, WITH SPECIAL REFERENCE TO SOIL FERTILITY. Assistant Porfessor PETTIT.

105. DETAILED STUDY OF SOIL INVESTIGATIONS IN PROGRESS IN ILLINOIS. Professor HOPKINS, Assistant Professor PETTIT.

107. EROSION OF SOILS BY SURFACE WASHING AND METHODS OF PREVENTION. Assistant Professor MOSIER.

108. THE MECHANICAL COMPOSITION OF SOILS; ITS INFLUENCE UPON GRANULATION, ABSORPTION AND RETENTION OF MOISTURE, AND OTHER PHYSICAL PROPERTIES AFFECTING CROP PRODUCTION.

Assistant Professor MOSIER.

109. EXPERIMENTATION IN THE PRODUCTION OF FIELD CROPS.—The work may include actual practice in planting and conducting field experiments. Mr. HUME.

112. PLANT BREEDING, INCLUDING A DETAILED STUDY OF EXPERIMENTS AT THIS STATION, AND OF METHODS AND RESULTS REPORTED FROM OTHER STATES AND FROM FOREIGN COUNTRIES.

Assistant Professor SMITH.

118. SEMINARY.—Investigation and thesis work.

Professor HOPKINS.

Courses for Graduates and Advanced Undergraduates

9. Soil Physics and Management.—*Five times a week. I.*
Assistant Professor Mosier.

12. Soil Fertility, Fertilizers, Rotations.—The influence of fertility, natural or supplied, upon the yield of various crops; effect of different crops upon the soil and upon succeeding crops; etc. *Five times a week. II.* Professors Hopkins.

15. Comparative Agriculture.—Lectures. *Once a week.*
Professor Davenport.

16. German Agricultural Readings.—The current numbers of German journals on agricultural science are required as a text. *Twice a week. II.* Professor Hopkins.

18. Investigation and Thesis.—*I, II.*
Professor Hopkins and others.

ANIMAL HUSBANDRY

Courses for Graduates

103. Live Stock Experimentation.—Objects, methods and the sources of error in experimental work dealing with the feeding, breeding and management of farm animals. Critical study of live stock experiments at this and other experiment stations.
Professor Mumford.

104. Meat.—Study and investigation of meat and by-products yielded by farm animals, with reference to the influence of various factors, the extent of variation, and methods of improvement.
Mr. Hall.

106. Swine.—The various factors in the principles of animal nutrition that have to do with the large and economical production of pork and the determination of type in swine.
Assistant Professor Dietrich.

110. Animal Nutrition.—This course includes a thorough study of the chemical and physiological changes, reactions, and processes involved in the activities of animal life, namely, mastication, digestion, absorption, assimilation, disassimilation, respiration, circulation, secretion and reproduction. *I, II.*
Professor Grindley and Mr. Emmett.

111. Animal Nutrition.—An advanced course for the detailed study of methods employed in the examination and analysis of feeding stuffs and animal substances, including flesh, fat, bone, urine,

feces, and manufactured animal products. This is a combined classroom and laboratory course. *I, II.* Professor GRINDLEY. Mr. GILL.

112. BACTERIOLOGY.—Investigation upon microorganisms related to the animal body in health and disease.

(a) Bacteriology of the digestive tract;

(b) Bovine tuberculosis;

(c) Infectious abortion of cattle. Dr. MACNEAL.

113. BACTERIOLOGY OF ANIMAL FOOD PRODUCTS. Dr. MACNEAL.

115. THESIS.—A thesis is required of students taking either the degree of Master of Science or Doctor of Philosophy.

116. SEMINARY.—Review of current literature relating to research in feeding, breeding and economic aspects of live stock production and in the chemical, physiological and bacteriological problems of animal nutrition. Also, a discussion of the more technical features and methods involved in investigations in progress at this station. *I, II.* Professor MUMFORD and other members.

Courses for Graduates and Advanced Undergraduates

7. PRINCIPLES OF ANIMAL NUTRITION.—*First half; daily. I.* Assistant Professor DIETRICH.

12.—BREEDS OF BEEF CATTLE.—*First half; daily. II.* Professor MUMFORD.

14. MANAGEMENT OF PURE-BRED HERDS, FLOCKS AND STUDS.—*Second half; daily. II.* Professor MUMFORD.

22. ADVANCED STOCK JUDGING.—A study of animal conformation with reference to market and show yard form, quality, and condition. *Daily; II.*

DAIRY HUSBANDRY

Courses for Graduates

101. ECONOMIC MILK PRODUCTION.—A special study of differences in the efficiency of dairy cows, cause and effect of the same, and the relation this bears to successful dairy farming. *Twice a week. I, II.* Professor FRASER.

102. RESEARCH.—A careful study of the investigations in progress in the dairy herds of the state. *Twice a week. I, II.* Professor FRASER.

103. RESEARCH.—Dairy feeding problems. *Twice a week, I, II.* Mr. HAYDEN.

104. Butter Production.—Different methods of handling cream and their relation to the quality of the butter. *Twice a week, I, II.*

Assistant Professor Lee.

105. Butter Production.—A study of the control of the water, salt, and casein content of butter and the relation they bear to the marketable product. *Twice a week. I, II.*

Assistant Professor Lee.

Courses for Graduates and Advanced Undergraduates

7. Factory Management.—Lectures, assigned readings, and laboratory work. *Three times a week. II; second half.*

Assistant Professor Lee.

8. City Milk Supply.—Proper methods of handling and preparing milk and cream for direct consumption; preventing contamination, pasteurizing, standardizing, modifying, bottling, transporting, and delivering. Certified milk; value of milk as a food. Milk commissions; legal requirements of cities and states. *II; second half.*

21. Economic Milk Production.—*Five times a week. II.*

Professor Fraser.

HORTICULTURE

Courses for Graduates

Exceptional opportunity is afforded for exhaustive studies in problems concerning orchard management, spraying, packing, storing, and marketing of fruits and vegetables. There is also ample provision for research work in certain phases of landscape gardening and forestry.

At least two years of collegiate work in horticulture and allied subjects and the requisite preparation for the chosen subjects are required for entrance upon major work in this department.

101. Pomology.—Studies of special problems regarding the relationship, adaptations, improvement, propagation, cultivation, pruning, protection, preservation or marketing of orchard fruits.

Professor Blair and Associate Professor Crandall.

102. Pomology.—Studies of special problem regarding the adaptions, propagation, cultivation, and pruning of small fruits.

Associate Professor Crandall.

103. Olericulture.—Studies of special problems regarding

the structure, cultural requirements, and improvements of vegetables. Assistant Professor LLOYD.

104. FORESTRY.—Problems in general forestry and investigation of forest growths. Professor BURRILL.

Courses for Graduates and Advanced Undergraduates

6. NURSERY METHODS.—A study of some details of nursery management and their relation to horticulture in general. *II; first half; daily.* Associate Professor CRANDALL.

7. SPRAYING.—The theory and practice of spraying plants, embracing a study of materials and methods employed in the combating of insects and fungous diseases. *II; second half; daily.* Assistant Professor LLOYD.

8. ORCHARDING.—A comprehensive study of pomaceous fruits (apple, pear, quince), and drupaceous or stone fruits (plum cherry, peach, nectarine, apricot). *II; daily.* Associate Professor CRANDALL.

10. LANDSCAPE GARDENING.—A course in ornamental and landscape gardening with special reference to the beautifying of home surroundings. *Three times a week. I or II.* Assistant Professor WYMAN.

12. EVOLUTION OF HORTICULTURAL PLANTS.—Comprising a study of organic evolution and the modification of plants by domestication. *I; second half; daily.* Associate Professor CRANDALL.

24. LANDSCAPE HORTICULTURE.—Exhaustive studies of ornamental plants and methods of grouping the same for the effective planting of public and private grounds, *I, II; Friday or Saturday.* Assistant Professor WYMAN.

THREMMATOLOGY

Courses for Graduates and Advanced Undergraduates

1. The principles of evolution as applied to the improvement of domesticated animals and plants. Variation, its extent and causes. Relative stability and instability of living matter. Reflex action, habit, and instinct, as bearing upon the question of inheritance of acquired characters. The origin, correlation, and disappearance of characters. Transmission and the law of heredity as developed by the statistical method of study. Power of selection to modify type. *Five times a week. II.* Professor DAVENPORT.

2. INVESTIGATION AND THESIS.—*Five times a week. I, II.* Professor DAVENPORT.

THE GRADUATE SCHOOL

OF THE

UNIVERSITY OF ILLINOIS

ANNOUNCEMENT FOR

1910-1911

URBANA-CHAMPAIGN, ILLINOIS

PUBLISHED BY THE UNIVERSITY

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THE UNIVERSITY CALENDAR, 1910-11

As applicable to the Graduate School

First Semester, 1910-11

1910	
Sept. 14, Wednesday, 8 a. m.	Entrance examinations begin
Sept. 19, 20, Monday and Tuesday	Registration days
Sept. 21, Wednesday, 8 a. m.	Instruction begins
Oct. 3, Monday, 4 p. m.	Senate meeting
Nov. 1, Tuesday	Latest day for formal announcement of thesis subjects for masters' degrees and for professional engineering degrees
Nov. 23, Wednesday, 12 m.	Thanksgiving recess begins
Nov. 28, Monday, 12 m.	Instruction resumed
Dec. 2, Friday	Illinois Day
Dec. 5, Monday, 4 p. m.	Senate meeting
Dec. 22, Thursday, 12 m.	Christmas Holiday recess begins
Dec. 30, Friday 5 p. m.	Latest date for submission of outlines of proposed theses by candidates for professional degrees in engineering
1911	
Jan. 3, Tuesday, 12 m.	Instruction resumed
Jan. 26, Thursday, 8 a. m.	Semester examinations begin
Feb. 2, Thursday, 5 p. m.	First semester ends

Second Semester, 1910-11

Feb. 6, 7, Mon. and Tues.	Registration days
Feb. 7, Monday, 4 p. m.	Senate meeting
Feb. 8. Wednesday. 8 a. m.	Instruction begins
Feb. 12, Sunday	Lincoln Day
March 7, Tuesday	Annual meeting of Board of Trustees
April 1, Saturday, 5 p. m.	Latest date for filing completed theses by candidates for professional degrees in engineering

April 3, Monday, 4 p. m.	Senate meeting
April 6, Thursday, 12 m.	Easter recess begins
April 11, Tuesday, 12 m.	Instruction resumed
May 13, Saturday, 12 m.	Latest date for receipt by Dean of certified doctors' theses
May 30, Tuesday	Military day
June 1, Thursday, 8 a. m.	Semester examinations begin
June 3, Saturday, 12 m.	Latest time for receipt by Dean of certified masters' theses
June 8, Thursday, 4 p. m.	Semester examinations close
June 11, Sunday	Baccalaureate address
June 12, Monday	Class day
June 13, Tuesday	Alumni day
June 14, Wednesday	Fortieth annual commencement

THE EXECUTIVE FACULTY

Of the Graduate School

Edmund Janes James, Ph. D., LL. D., President of the University

Thomas Jonathan Burrill, Ph. D., LL.D., *Vice-President, Professor of Botany.*

David Kinley, Ph.D., LL. D., *Dean of the Graduate School and Professor of Economics.*

Stephen Alfred Forbes, Ph. D., LL.D., *Director of the Illinois State Laboratory of Natural History and State Entomologist, Professor of Entomology.*

Albert Pruden Carman, A. M., Sc. D., *Professor of Physics.*

William Freeman Myrick Goss, D. Eng., *Dean of the College of Engineering, Director of the School of Railway Engineering and Administration.*

Guy Stanton Ford, Ph. D., *Professor of Modern European History.*

Chester Noyes Greenough, Ph. D., *Professor of English.*

George Abram Miller, Ph. D., *Professor of Mathematics.*

William Albert Noyes, Ph. D., *Professor of Chemistry and Director of the Chemical Laboratory.*

Julius Goebel, Ph. D., *Professor of Germanic Languages.*

Louie Henrie Smith, Ph. D., *Assistant Professor of Plant Breeding, Assistant Chief of Plant Breeding in the Agricultural Experiment Station.*

HISTORY AND ORGANIZATION

Although for many years the University of Illinois has offered advanced students facilities for study and research in various lines, graduate work was undertaken under the name of the Graduate School for the first time in 1892. Beginning with that year each department offered such work as it could, without the organization of a separate Graduate School Faculty. In 1894 the administration of the school was vested in the Council of Administration and the Vice-President of the University became Dean of the School. As yet, however, the School had no executive faculty separate from the faculty of the undergraduate colleges.

In 1906 the Graduate School was organized as a separate faculty, consisting of a dean and members of the University faculty assigned to this duty by the President. No means of support, however, were provided, separate from those provided for undergraduate work. In the winter of 1906-7, the Forty-fifth General Assembly of the State passed an act appropriating $50,000 per year for the support of a Graduate School of the Arts and Sciences in the State University. This is the first time in history in which a State Legislature has made a specific appropriation for such a purpose and the act is noteworthy as committing a democratic government definitely to the promotion of advanced scholarship and research in subjects which are cultural as well as "practical." The executive faculty was accordingly organized, and steps were taken to put certain departments in suitable condition to do advanced work.

By act of the Trustees the teaching faculty of the Graduate School includes all members of the University faculty who give instruction in courses approved for graduate credit. The affairs of the School, however, are in charge of the executive faculty.

ADMISSION

Admission to the Graduate School is conditioned upon the presentation of credentials showing that the applicant holds a first degree either from the University of Illinois or from some other university or college of approved standing. Admission to particular graduate courses or departments may be secured only by those who have had the requisite undergraduate work in those courses or departments. If any student wishes to take graduate work in a department in which he has not the necessary preliminary undergraduate training, he must secure this preparation in the undergraduate courses without credit towards an advanced degree.

In order to be enrolled as a member of the Graduate School a student must be doing graduate work. The possession of a first degree does not entitle a student to be enrolled in the Graduate School, if the courses which he is taking are undergraduate.

Students of mature age, who do not hold a first degree, but satisfy the dean of the school and the officers of the departments in which they wish to work of their earnestness of purpose and special fitness, may be permitted to take work in the Graduate School without reference to candidacy for a degree. In order to secure this permission, however, a candidate must have had such preliminary preparation for the work he wishes to take up as would justify his admission to the Graduate School as a candidate for a degree if he could meet the formal requirements fully.

Application blanks for admission may be secured from the Dean of the Graduate School or from the Registrar of the University, and these, properly filled out, should be filed with such documentary matter as the candidate can offer, showing qualifications for membership, not later than the registration days.

REGISTRATION

Each graduate student must register when he first connects himself with the University, and afterwards at the beginning of each semester. The first registration, however, or that upon entrance, is permitted only after the student's application for admission to the Graduate School, setting forth his educational attainments, has been duly approved.

After the application for admission has been approved the student receives from the Dean a permit to register and also a

study blank. This study blank must be filled out with the advice of the professors in charge of the selected work. The student must then pay his fees at the business office, secure a receipt therefor and return this receipt with the approved study blank to the Dean.

Each student is required to attend a minimum of four class, lecture, or laboratory, exercises, per week, in the first year of his graduate study; and in no case is he permitted during his course to attend more than twelve per week.

Residence.—Excepting as noted below, continuous residence and study are required of all members of the Graduate School, unless they are granted leave of absence by the Dean, upon recommendation of the professors in charge of their work, for the purpose of carrying on elsewhere studies or investigation in the line of work for their degrees.

Graduates of the University of Illinois, but no others, may be permitted to carry on graduate work for a second, or master's, degree *in absentia*. All such students must make out the usual application for admission, must submit their proposed courses of study to the Dean, whose approval, together with that of the professor in charge of the work, is necessary, before the student can be enrolled. Students who wish to pursue their graduate work *in absentia* are required to submit evidence that they have at their place of residence sufficient equipment in the way of libraries or apparatus to pursue the course of study proposed.

CHARACTER OF GRADUATE WORK

The work expected from graduate students is different in character from that usually demanded from undergraduates. Regularity of attendance, wide knowledge and ability to meet examination tests are of secondary importance. The principal aim of graduate study is the development of the power of independent work and the promotion of the spirit of research. Consequently, before he can get his degree, each graduate student is expected to show that he has acquired the power of independent research. In addition, each candidate is expected to have a wide knowledge of his subject and of related fields of work, for the graduate student is not expected to get from lecture and laboratory courses all the knowledge and training necessary to meet the requirements for his degree. The class, lecture, or laboratory course is intended to present the principles or theory

of the subject and serve as a model or guide to the student in his private reading and research.

Students are warned against restricting themselves merely to the courses prescribed or suggested by the departments in which they are studying. Each student is expected to do a wide range of private reading and study; and in many cases will find it advisable to take one or more courses of lectures quite outside the field of his chosen subjects.

THE MASTERS' DEGREES

Candidates for the degree of Master of Arts or Master of Science are required to do one year's work in residence and to write a thesis.

The mention of one year as the required residence period does not imply, however, that a degree will be obtained in one year. If the candidate is inadequately prepared, or if his time and strength are impaired during the first year of residence by other matters, he will be required to spend a longer time.

While the work of a candidate for a master's degree consists largely in a broadening of the knowledge of his subjects of study, and not, to so great an extent, at any rate, as in the case of the candidate for the doctorate, in the development of the power of original research; nevertheless, the work of the candidate must be of a high order and must be such as to satisfy the faculty that he has done more that merely acquire a certain amount of knowledge by rote.

Each candidate for a master's degree may do all his work in one subject, or he may select a major and one minor, or a major and two minors. A major or minor denotes the field of knowledge of a department, or such part thereof as constitutes a separate and independent division of that field. However, the candidate must do at least half his work in his major subject. Each candidate for a master's degree is also required to present a thesis on some subject approved by the professor in charge of his major work, and the Dean of the School. The requirement of a thesis may be waived, however, upon the recommendation of the head of the department in which the student is doing his major work, and the approval of the Dean. Permission to take the degree without a thesis must be obtained not later than the latest date for the approval of thesis subjects, as shown by the calendar.

Graduates of this University are permitted to secure their degrees on doing one year's full work *in absentia*, but this work

must be spread over at least three years from the time of registration. Work *in absentia* is not permitted unless the student satisfies the Dean and the professors in charge of his work that he has the facilities to do it properly.

Candidates who are working for a master's degree *in absentia*, without a thesis, must present themselves at the University for examination not later than the first Monday of June of the year in which they wish their degree.

The completed theses of non-resident candidates for degrees must be filed by April first.

The Master's Degree in Engineering

Two classes of second degrees are open to graduates of the College of Engineering, namely, academic and professional.

The *academic* second degree in engineering is Master of Science, following Bachelor of Science, in Architecture, Architectural Engineering, Civil Engineering, Electrical Engineering, etc. This degree is conferred in accordance with the regulations described above *for work in residence only.*

The *professional* second degrees in engineering are as follows:

Master of Architecture after B. S. in Architecture.

Architectural Engineer after B. S. in Architectural Engineering.

Civil Engineer after B. S. in Civil Engineering or B. S. in Municipal and Sanitary Engineering.

Electrical Engineer after B. S. in Electrical Engineering.

Mechanical Engineer after B. S. in Mechanical Engineering.

Civil Engineer, Electrical Engineer or Mechanical Engineer, after B. S. in Railway Engineering, according to the course.

Professional degrees are conferred upon two classes of candidates: 1. Graduates of the College of Engineering of the University of Illinois who have been engaged in acceptable professional work away from the University for a period of not less than three years after receiving the degree of Bachelor of Science. 2. Graduates of the University of Illinois, or of institutions of equal standing, who have been engaged in acceptable professional work in residence at the University for a period of not less than three years after receiving the degree of Bachelor of Science.

In "acceptable professional work" may be included contributions to technical literature, activity in professional societies, investigations of engineering problems, and the teaching of engineering subjects.

A candidate must declare his candidacy and file with the Dean of the College of Engineering, as chairman of the committee in charge, a detailed statement covering his professional study and experience, not later than the first Monday in November preceding the commencement at which he purposes to qualify. Prior to December 31 next succeeding, he must submit for approval an outline of his proposed thesis, and he must file his completed thesis not later than April 1. If the statement of professional experience and study and the thesis are acceptable, the candidate must present himself at commencement in order to receive the degree.

Candidates for professional engineering degrees who already hold the degree of Master of Science, may qualify for the professional degree after two years of professional work, other conditions being the same as those prescribed for candidates holding the degree of Bachelor of Science.

THE DEGREE OF DOCTOR OF PHILOSOPHY

General Statement of Requirements.—The requirements for the degree of Doctor of Philosophy are a thorough mastery of a selected field of study, evidence of the power of independent investigation in this field, a broad knowledge of the wider field of study of which this major subject is a part, a general acquaintance with related fields of knowledge and a mastery of all branches of study which are necessary to a full knowledge of the main subject. Each student who is seeking this degree is expected to choose for study and final examination a major subject, or field of study, and a first and second minor. The major subject is the field in which the student expects to become expert and an authority. The first minor must be a subject closely related to the major and may, under certain conditions and with proper approval, be a sub-division of the major field of study. The second minor should be chosen outside of the major field of study.

When a candidate chooses any subject as his major, and a division of that subject as his first minor, he is not permitted to choose as a second minor any division of work in that same department, excepting by vote of the executive faculty of the School.

The candidate's list of subjects must receive the approval of the head of the department in which he chooses his major work and of the Dean of the School.

Period of Study.—The minimum period of study required for securing the degree of Doctor of Philosophy is three years, and if a candidate of ability enters the Graduate School fully qualified to take up immediately the work leading to a doctorate and devotes all his time to the pursuit of his purpose, he will usually succeed in getting his degree at the end of three years. If, however, he begins his work without full preparation, or his strength is partly devoted to other matters, he will be required to spend a longer time. In any case, the degree is conferred not for residence during a certain period, but for scholarly attainments and power of investigation, as proved by thesis and examinations.

Candidates should note that "credit" is not given for work done in other universities, excepting in the sense that their residence at other institutions is counted towards the residence requirement for the doctor's degree. The candidate is examined here on the subjects offered by him for the advanced degree.

At least the first two or the last one of the three years required must be spent at this University.

Examinations.—Towards the end of his second year of study, or, by special permission, at the beginning of his third year, the candidate for the degree must submit to a preliminary examination conducted by the members of the faculty with whom he is doing his principal work, in order to determine whether he will be accepted as a candidate for the degree in the following year. This examination is partly oral, and may be wholly so. At this time, or before, the candidate will be required to demonstrate his ability to read French and German, and any other language needed for the prosecution of his work. Excepting where the chosen field of study itself includes the languages, the examinations in languages are conducted simply to determine whether the student is able to use the language as a tool for the purpose of investigation.

On or before the last Monday in May of the year in which the candidate expects to come up for his degree, he must submit to a final examination by a committee appointed by the Dean of the Graduate School. This examination will be partly written. The candidate will also have, however, an oral examination. These examinations will not be confined to the courses which the candidate has attended in the University of Illinois only, if he has done part of the work elsewhere; nor even to the

field covered by the courses specifically taken in this or other universities; but will be so conducted as to determine whether the candidate has a satisfactory grasp of his major subject as a whole, and a general acquaintance with the broad fields of knowledge represented by his course of study.

Before the candidate is admitted to the final examination and the defense of his thesis, he may be required to take any other examination, oral or written, that is thought proper by the various departments in which he has studied. If after having passed his preliminary examination, he fails in the third year of his study to meet the expectations of the professors in charge of his work, or in any way fails to maintain the standard of scholarship and power of research expected of him, he may be refused admission to the final examination.

The final examination in the major and minor subjects may not be divided. The examination must be taken all at one time even though it requires several sessions.

Thesis.—The power of independent research must be shown by the production of a thesis on some topic connected with the major subject of study. The thesis must be the result of the author's own investigation. Acquaintance with the literature of the subject will not secure the acceptance of the thesis if it does not show real power of research. The candidate is expected to defend his thesis or dissertation before the members of the faculty, or as many of them as may wish to question him about it, in connection with his final examination.

The subject of the thesis should be chosen not later than the end of the second year of study and must be submitted for formal approval not later than the first Monday of November of the year when the degree is expected. A typewritten copy of the completed thesis must be in the hands of the Dean not later than noon of May thirteenth.

The thesis must be printed and one hundred copies deposited in the library of the University before the degree is conferred. But if, for any reason, the thesis cannot be printed and one hundred copies deposited before commencement time, the candidate must, before the first Monday in June, deposit a bond acceptable to the Comptroller of the University and the Dean of the Graduate School for the cost of printing his thesis, or such part thereof as may be regarded as sufficient to meet the requirements of the rules.

The title page of each thesis must bear the words "Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in—(here put the major subject), in the Graduate School of the University of Illinois." The title page must also contain the full name of the author, the full title of the thesis, the year of imprint, and, if a reprint, the title, volume and statement of the pagination of the volume from which it is reprinted. Each thesis must have an appendix giving a short educational history of the candidate, including the institutions he has attended, his degrees and honors, the title of his publications, and such other matters as may be pertinent.

SCHOLARSHIPS AND FELLOWSHIPS

A number of fellowships and scholarships have been established by the Trustees of the University. To first year graduate students of ability and promise there are open a number of scholarships with a stipend of $250 each and freedom from tuition, incidental and laboratory fees. To second and third year graduate students, that is, those who have had one or two years of graduate study, there are open fellowships with a stipend varying from $300 to $500, with freedom from fees. The larger stipends are given only to students who are expected to take their degrees within the year. Each holder of a fellowship must pay the matriculation fee of ten dollars, unless he holds a first degree from the University of Illinois, and also the diploma fee of five dollars on receiving his diploma.

Candidates for these scholarships and fellowships must be graduates of the University of Illinois, or of colleges or universities having equivalent requirements for bachelors' degrees.

Application must be made upon blanks provided for the purpose, to be obtained from the Dean of the Graduate School. These application forms should be addressed to the Dean of the Graduate School as early as possible in February of the academic year preceding that for which the fellowship is desired.

Applications for scholarships and fellowships should be accompanied with full information concerning the applicant, and with any written or printed essays or results of investigation which he can submit.

Applicants for fellowships are required to send the Dean of the Graduate School prompt notice of their acceptance or refusal; and to agree that, if accepted, the fellowship will not be

resigned to take a fellowship in any other institution during the year for which it is awarded.

Nominations to fellowships are made upon the grounds of worthiness of character, scholastic attainments, and promise of success in the principal line of study or research to which the candidate proposes to devote himself.

Scholars and fellows are members of the Graduate School and have all the privileges and bear all the responsibilities of such membership.

Scholarships and fellowships are good for one year, but may be renewed for a second or a third year in special cases. An appointment as honorary fellow, without stipend, may be made as specified for paid fellowships in the case of any one who has shown distinguished merit in his work.

Fellows may be required to assist in laboratories or classes in furtherance of their training for careers as investigators or teachers.

Research Fellowships in the Engineering Experiment Station

The Engineering Experiment Station, devoted entirely to research, was established by action of the Board of Trustees, December 8, 1903. Its purposes are the stimulation and elevation of engineering education, and the study of problems of special importance to professional engineers and to the manufacturing, railway, mining, and industrial interests of the state and the country.

Ten fellowships, each of five hundred dollars a year, have been established in the Engineering Experiment Station. Applicants to whom these fellowships are awarded are required to agree to hold them for two years, devoting a part of their time to work in the Engineering Experiment Station of the University. Application for these fellowships should be made to the Director of the Engineering Experiment Station.

LIBRARIES

The general University library, the library of the State Laboratory of Natural History, that of the Agricultural Experiment Station, and that of the College of Law are all at the University in Urbana. The libraries of the College of Medicine and the School of Pharmacy are in Chicago.

The general University library contains 144,000 volumes and 20,000 pamphlets. The University has a subscription list of 1,675 periodicals. The library of the State Laboratory of National History contains 7,200 volumes and 17,900 pamphlets. The library of the College of Law contains the Federal and State Reports, the leading textbooks, and a line of leading periodicals. The department of education has made a special collection of about 1,500 books and 3,000 pamphlets, which are kept in the rooms of the department in University Hall. This collection contains a very good assortment of modern text books, and copies of the courses of study of nearly all the large city school systems.

The general library of the University is open daily, from 8 a. m. until 10 p. m. and on Sunday from 2 p. m. to 6. p. m.

The Mason Historical Library.—The valuable library of western history collected by Edward G. Mason, Esq., long president of the Chicago Historical society, is in the Public Library of the city of Champaign, and is accessible to University students.

The Dittenberger Classical Library.—The University has recently acquired the library of Wilhelm Dittenberger, Professor of Classical Philology in the University of Halle. This library contains 5,600 items and is especially valuable for the literary study of the classical languages. It includes, in the best editions, the works of the poets and prose writers, both Greek and Latin, and numerous works on grammar and history of literature, with between four and five thousand dissertations and programs on special topics. In addition there are many works dealing with the other departments of classical philology, as epigraphy, history of ancient peoples, archaeology, philosophy, history of art, geography, chronology, metric, etc.

The Heyne Library of Germanics.—The entire library of Professor Moritz Heyne of the University of Göttingen was bought in 1909. It contains about 5200 volumes. The collection is rich in the general field of German philology and especially in lexicography. It has many rare first editions of works of German literature from the sixteenth, seventeenth and eighteenth centuries, and has sets of a number of rare periodicals. It is also rich in works upon the history of German civilization.

Other special library facilities of various departments are mentioned in connection with those departments.

FEES AND EXPENSES

Except as noted below, graduate students pay fees as follows:

Matriculation fee	$10.00
Incidental fee, each semester	12.00
Diploma fee	5.00

All graduate students who have not matriculated as undergraduates at the University of Illinois pay the matriculation fee on entrance.

All graduate students pay the diploma fee on being recommended for their degrees.

No tuition charge or incidental fee is made for graduate courses to scholars, fellows, or members of the corps of instruction or the staffs of the scientific bureaus or experiment stations, nor for undergraduate courses on their study lists if approved by the heads of the departments and by the Dean of the School as necessary or desirable for the proper completion of the work for the degree. Otherwise, graduate students who take undergraduate courses must pay the proper undergraduate fee.

Each student working in laboratories, or in the drafting or engineering classes, is required to make a deposit of from 50 cents to $10.00, to pay for chemicals and apparatus used, and for any breakage or damages. But no charges or deposits for laboratory materials are required from scholars, fellows, or from members of the corps of instruction or scientific staffs mentioned above.

Table board may be obtained at prices ranging from $4.00 per week.

Room rent, with two in a room, ranges from $2.50 per week, per person.

DEPARTMENTS OF INSTRUCTION

Courses are offered in the following groups of subjects:

A. Languages and Literatures.
B. History and the Social Sciences.
C. Education, Philosophy and Psychology.
D. The Physical Sciences, including Mathematics.
E. The Biological Sciences.
F. Engineering.
G. Agriculture.

A. Languages and Literatures

THE CLASSICAL LANGUAGES

Greek

Preparation for graduate work in Greek should include two years of college Greek in addition to entrance requirements.

Courses for Graduates

103. Principles of Comparative Grammar.—This course may be counted either for Greek or Latin credit. *Three times a week; first semester.* Dr. Canter.

104. Homer and the Homeric Question. *Twice a week; both semesters.* Associate Professor Oldfather. (Alternates with 105.)

105. Plato and Aristotle. *Twice a week; both semesters.* (Alternates with 104). Associate Professor Oldfather.

106. Greek Drama. *Twice a week; both semesters.* Professor Moss.

107. Greek Oratory. *Twice a week; both semesters.* Professor Moss.

108. Hellenistic Greek. (106, 107, and 108 are given in a three years' cycle.) *Twice a week; both semesters.* Professor Moss.

Course for Graduates and Advanced Undergraduates.

21. Beginning Greek.—Elementary Composition and Grammar; Lectures on Greek Literature. *Four times a week; both semesters.* Professor Moss.

Latin

Students desiring to take graduate work in Latin should have had three years of college Latin in addition to Latin presented to meet entrance requirements.

Courses for Graduates.

103. Cicero De Natura Deorum, and De Divinatione. *Twice a week; first semester.* Assistant Professor Pease.

104. Palaeography. *Once a week; first semester.* Assistant Professor Pease.

105. Latin Poetry. *Twice a week; second semester.* Assistant Professor Pease.

106. Comedy. *Twice a week; both semesters.* Associate Professor Oldfather.

107. Epigraphy. *Twice a week; second semester.*
Assistant Professor Pease.

108. Tacitus, the Histories. *Twice a week; second semester.*
Professor Barton.

Courses for Graduates and Advanced Undergraduates.

14. Seneca.—Selections from his Essays, Letters, and Tragedies. *Three times a week; first semester.* Professor Barton.

16. Martial and Suetonius.—Selections. *Three times a week; second semester.* Associate Professor Oldfather.

ENGLISH

The Degree of Master of Arts in English.—In addition to complying with the general rules of the Graduate School candidates for the degree of Master of Arts in English must comply with the following rules of the department of English:

Candidates must take, in addition to the courses required for the first degree (1) a certain number of courses "for graduates"; (2) an elementary course in Anglo-Saxon if such a course has not previously been taken. They may not include, for credit, English 1, 2, 15, 16, or 23, or any courses in rhetoric except 12, 15, 16, and 20, and must satisfy the department of their ability to write acceptable English.

As a rule, candidates must take the regular semester examinations in all their courses. They must also take special examinations as follows: a written examination, lasting about three hours, which must cover not only the field of the courses taken, but also the general fields of English and American literature and the outlines of the history of the English language: an oral examination which shall be a final test of the candidate's general fitness and ability.

The Degree of Doctor of Philosophy in English.—In addition to the general rules and suggestions for all candidates for the degree of Doctor of Philosophy the following departmental rules and suggestions are to be noted.

From the following list of topics grouped below there must ordinarily be chosen:

By all:	the whole of G, H, and I, either 4 or 5 in Group A, Beowulf, Chaucer, Shakspere, and Milton.
By those whose main interest lies in Group B:	All of A, B, and C; 3 from D; 2 from E; 2 from F.

By those whose main interest lies in Group C: 3 from A; all of B and C; 4 from D; 2 from E; 2 from F.

By those whose main interest lies in Group D: 1 from A; 2 from B; 2 from C; All of D; 3 from E; 3 from F.

By those whose main interest lies in either Group E or Group F: 1 from A; 2 from B; 2 from C; 3 from D; all of E and F.

Group A

1. Gothic.
2. Old French.
3. Old Norse.
4. History and Principles of English Grammar.
5. History of the English Language.

Group B

1. Anglo-Saxon Language and Versification.
2. Anglo-Saxon Prose.
3. Beowulf.
4. Other Anglo-Saxon Poetry.

Group C

1. Middle English: Language.
2. Middle English Literature: Ballads.
3. Middle English Literature: Romances.
4. Middle English Literature: Chaucer.
5. Middle English Literature. Lydgate, Gower, Wyclif, etc.
6. Middle Scottish Language and Literature.

Group D

1. Drama before Shakspere.
2. Shakspere.
3. The Drama from Shakspere to 1642.
4. Elizabethan and Jacobean Non-Dramatic Poetry.
5. Elizabethan and Jacobean Prose.
6. Milton.

Group E

1. The Period of Dryden.
2. The Period of Pope.
3. The Period of Johnson.
4. American Literature to 1800.

Group F

1. The Earlier Romantic Movement.
2. The Period of Wordsworth.
3. The Period of Tennyson.
4. American Literature since 1800.

Group G

1. The History and Principles of Literary Criticism, especially of English Literary Criticism.
2. The History and Principles of English Versification.

Group H

1. English and American History in Outline.
2. A much more thorough knowledge of the history of England during the period upon which the candidate concentrates his attention. (If the candidate's special interest is in American literature, both English and American history will be required).
3. A fair knowledge of the history, during the period upon which the candidate concentrates his attention, of the country which is then most closely related to English literature.
4. A general knowledge of the history of modern philosophy.
5. A much more thorough knowledge of philosophy during the period upon which the candidate concentrates his attention, with special reference to England and to that country whose literary relations with England are closest at that time.

Group I

1. A reading knowledge of French and German.
2. A general knowledge of Greek and Latin literature and mythology.
3. A general acquaintance with that literature which during the period upon which the candidate concentrates his attention stands in closest relation to English literature.

Students who expect to enter upon graduate work with English as their major subject are required to have taken twenty hours of English literature. They should also have taken at least one elective course in English composition, and should have read liberally outside of their courses. A reading knowledge of either French or German, as well as some acquaintance with those literatures, is desirable, though not required. Valuable auxiliary studies are classics, history, and philosophy.

Courses for Graduates

101. Research in Special Periods.—Competent graduate students are encouraged to seek the advice and assistance of the Department of English and to submit to the Department plans

for study in the language or literature of the periods mentioned below.

A. Anglo-Saxon Language and Literature.
Professor DODGE.

B. Thirteenth and Fourteenth Centuries. Dr. JONES.

C. Sixteenth Century.
Professor DODGE, Associate Professor SHERMAN.

D. Seventeenth Century. Assistant Professor BALDWIN.

E. Nineteenth Century. Associate Professor FULTON.
Associate Professor SHERMAN.

103. THE POETRY OF MILTON.—*Twice a week; second semester.*
Assistant Professor BALDWIN.

109. GERMAN AND SCANDINAVIAN INFLUENCES ON ENGLISH LITERATURE OF THE EIGHTEENTH AND NINETEENTH CENTURIES. *Twice a week; both semesters.* Professor DODGE.

110. ANGLO-SAXON POETRY. *Twice a week; both semesters.*
Professor DODGE.

112. THE HISTORY AND PRINCIPLES OF ENGLISH GRAMMAR. *Twice a week; both semesters.* Dr. ZEITLIN.

[Not given in 1910–11].

113. ENGLISH PROSE SYNTAX.—An historical study. *Twice a week; both semesters.* Dr. ZEITLIN.

126. ENGLISH BALLADS AND METRICAL ROMANCES. Students who elect English 126 are advised to take either with or before it English 7 (Chaucer) and Romance Languages 102 (Old French). *Twice a week; both semesters.* Dr. JONES.

127. MIDDLE ENGLISH.—Critical Reading of Middle English texts. *Twice a week; both semesters.* Dr. JONES.

136. THE TRANSITION FROM THE SEVENTEENTH TO THE EIGHTEENTH CENTURY IN ENGLISH LITERATURE. *Three times a week; both semesters.* Professor PAUL.

138. THE ROMANTIC MOVEMENT IN ENGLAND.—The attention of students who wish to take English 138 is called to History 7 (The Revolutionary and Napoleonic Era).
Twice a week; both semesters. Associate Professor SHERMAN.

139. THE HISTORY OF ENGLISH POETRY. *Twice a week; both semesters.* Associate Professor SHERMAN.

Courses for Graduates and Advanced Undergraduates

4. THE HISTORY AND PRINCIPLES OF ENGLISH VERSIFICATION.—Theory of English metre and rhythm; history of the

development of the forms of English verse. *Twice a week; second semester.*

[Not given in 1910–11].

5. Shakspere and his Predecessors.—The second semester, which will be devoted to Shakspere, may be taken without the first. *Three times a week; both semesters.* Professor Dodge.

6. The History of English Literary Criticism.—A brief discussion of the leading critical principles laid down by Aristotle, Horace, Longinus will preface the main work of the course. *Three times a week; both semesters.*

Associate Professor Fulton.

7. Chaucer. *Three times a week; both semesters.*

Dr. Jones.

8. Old English (Anglo-Saxon).—Grammar, prose, short poems, the first half of Beowulf. *Three times a week; both semesters.* Professor Dodge.

11. The Principles of Criticism.—A discussion of some of the more notable theories of art, the nature and elements of literature, and the meaning and purpose of criticism. Students who take English 11 are advised to take either before or with it Philosophy 8 (Esthetics). *Twice a week; first semester.*

[Not given in 1910–11]. Associate Professor Fulton.

17. The History of the English Language. *Three times a week; both semesters.* Associate Professor Fulton.

GERMANIC LANGUAGES

German

Students desiring to take German as a major are expected to have finished successfully a four years' course of undergraduate work in German, corresponding to the four years' course in German at this University. They are expected to be familiar with the principal works of the writers of the classical and modern periods of German literature, to show a general knowledge of the history of German literature and to have the ability of following lectures in the German language.

Of collateral subjects, a reading knowledge of Latin and French is required. It is desirable that candidates for the degree of Ph. D. have some knowledge of Greek. All students are expected to have had a course in German History.

Courses for Graduates

101. Seminary in Germanic Philology.—The work is adapted to the abilities and tendencies of the students. The primary object is to give training in original research. The result of the work, when of value, may be published in the *Journal of English and Germanic Philology.* The subjects for 1910–11 will be Klopstock's Oden during the first semester, and Hölderlin during the second semester. *Twice a week; both semesters.*

Professor Goebel.

103. Introduction to the Historical Study of the Germanic Languages.—Lectures; discussions of special topics. History of German Philology. Comparative Grammar of the Old Germanic dialects. *Twice a week; second semester.*

Professor Goebel.

104. Gothic.—An introductory study of its grammer and literature. *Twice a week; first semester.* Professor Goebel.

105. Old High German.—Grammar and interpretation of the oldest literary documents. *Twice a week; second semester.*

Dr. Wiehr.

106. Middle High German.—Grammar and interpretation of selected texts. Open to seniors; especially recommended to candidates for teachers' certificates. *Twice a week; first semester.* Professor Goebel

109 Goethes und Schillers Philosophische Weltanschauung. *Twice a week; both semesters.* Professor Goebel.

110. Early German Drama.—The development of the German drama up to the Reformation, including the medieval religious drama, the Shrovetide plays and the beginnings of the Humanistic drama. *Twice a week; first semester.*

Assistant Professor Brooks.

113. German Literature of the Fifteenth and Sixteenth Centuries.—Survey of the literature on the background of the general history of the time. Luther and the Reformation, Mastersingers and Folksong, the Reformation drama, Hans Sachs, Brant, Fischart, the chap books, the English comedians. *Three times a week; second semester.*

Assistant Professor Brooks.

115. History of German Literature from Goethe's Death to the Present Time. *Twice a week; both semesters.*

Associate Professor Lessing.

116. History on Literary Criticism in Germany.—*Three times a week; second semester.* [Not given in 1910–11]
Associate Professor Lessing.

117. History of German Literature During the Eighteenth Century. *Twice a week; both semesters.*
[Not given in 1910–11]. Professor Goebel.

118. Studies in the History of the German Drama with Special Reference to Kleist and Grillparzer. *Both semesters.* [Not given in 1910–11.] Associate Professor Lessing.

119. The Modern German Novel.—*Once a week; both semesters.* Associate Professor Lessing.

121. Gudrun. Lectures and Interpretations. *Twice a week; second semester.* Professor Goebel.

123. The Romantic School.—The course deals with the literary side of early Romanticism in Germany. Lectures and reports on assigned topics. *Twice a week; first semester*
Dr. Wiehr.

124. History of the Drama.— Brief survey of the beginnings and earlier development, followed by a more intensive study of the drama in the eighteenth century. *Twice a week; first semester.* Assistant Professor Meyer.

Courses for Graduates and Advanced Undergraduates

8. Schiller.—The life of Schiller and study of Wallenstein and other selections. *Three times a weeks; first semester.*
Associate Professor Lessing.

9a. Goethe's Faust.—The Faust legend and early Faust books and plays, the genesis of Goethe's Faust, reading of both parts. *Twice a week; both semesters.* Professor Goebel.

9b. Goethe-Schiller.—Interpretation of Goethe's poems, Tasso and Schiller's Ueber naive and sentimentalische Dichtung. *Twice a week; both semesters.* [Not given in 1910–11.]
Professor Goebel.

11. German Literature After the Reformation.—Lectures, recitations and reports on assigned collateral reading. *Three times a week; second semester.* Associate Professor Lessing.

26. German Literature Before the Reformation.—Lectures, recitations, and reports on assigned reading. *Three times a week; first semester.* Associate Professor Lessing.

27. Lessing.—The life of Lessing and study of Nathan der Weise, Emilia Galotti, and other selections. *Three times a week; second semester.* Associate Professor Lessing.

29. Advanced Prose Composition.—An advanced teachers' course aiming to give some facility in idiomatic expression in speaking and writing German. Themes on Germany and German life, based on suitable reading, discussed in German. *Twice a week; both semesters.* Dr. Wiehr.

Scandinavian Languages

Preparation for graduate work in Scandinavian philology should include a general introduction to Germanic philology, such as is contained in a course in Gothic and Old English. However, a student who has, through systematic work, attained a high degree of efficiency in one of the modern Scandinavian languages may pass on to graduate work in Scandinavian Philology with the introductory work in Germanic philology. Preparation for graduate work in literature should include a thorough reading knowledge of the language and systematic work in the undergraduate courses in Scandinavian or the equivalent of these in other colleges.

Courses for Graduates

101. Old Norse.—Introduction to the language as a member of the Germanic group. Reading of the Volsungasaga with selections from the heroic lays. *Twice a week; both semesters.* Assistant Professor Flom.

102. Old Danish.—Introduction to the language. Reading of selections from the oldest texts and from ballads. *Twice a week; first semester.* Assistant Professor Flom.

103. Old Swedish.—Introduction to the language. *Noreen's Altschwedische Grammatik* and *Lesebuch* will be used. *Twice a week; second semester.* Assistant Professor Flom.

110. Advanced Old Norse.—A critical study of all the lays of the *Elder Edda*, with selections from the *Thithreks saga* and the *Njals saga*. *Twice a week; both semesters.* Assistant Professor Flom.

Courses for Graduates and Advanced Undergraduates

11. Survey of the History of the Swedish Language and Literature.—Lectures. [Not given in 1910–11.] Assistant Professor Flom.

ROMANCE LANGUAGES

Before entering upon the duty of Romance Languages for an advanced degree, the candidate should have had a total of at least thirty hours of college work in these languages. Eighteen of these hours must be in one of the three languages, French, Italian, or Spanish, but no candidate will be received who has not had at least twelve hours of French. He must have a close, specific knowledge of at least one of these three languages, and a good reading knowledge of at least one other. In addition a candidate should have had good training in Latin, and be able to read ordinary German prose.

French

Courses for Graduates

102. Old French Readings.—First semester: Chrétien de Troyes and the court epic. Second semester: Readings from Marie de France, the prose chroniclers and the dramatists of the middle ages. *Twice a week; both semesters.*

103. Old French Phonology and Morphology.—Development of Old French from Vulgar Latin. *Twice a week; both semesters.* Associate Professor Carnahan.

125. Seminary.—An opportunity is given here for research in special fields of French and other Romance literatures.

Courses for Graduates and Advanced Undergraduates

10. General Survey of French Literature.—An introduction to more extended study of special periods and authors. The student becomes acquainted with some of the literary masterpieces of France and with the main currents of French Literature from the beginning to the present time. *Twice a week; both semesters.* Associate Professor Carnahan.

This course is strongly recommended to those who desire the endorsement of the department to teach French.

21. Modern French Novelists.—A study of the novel in France from the beginning of the nineteenth century to the present time. Hugo, de Vigny, Balzac, Flaubert, de Maupassant, Daudet, Zola, and living writers. Lectures. Reports on collateral reading. *Twice a week; both semesters.*

Associate Professor Carnahan.

24. The Seventeenth Century.—A study of the greater masterpieces of literature of the seventeenth century in France,

with especial emphasis upon the drama. *Twice a week; both semesters.*

SPANISH

Courses for Graduates

118. THE EARLY SPANISH SATIRISTS.—Juan Ruiz, Martínez de Toledo, Pero López de Ayala. A study of the life of the times as shown by the satirists. *Once a week; both semesters.*
Dr. SEYMOUR.

121. OLDEST MONUMENTS OF THE SPANISH LANGUAGE.—Historical grammar and palaeography. *Once a week;both semesters.*
Assistant Professor FITZ-GERALD.

122. ORIGINS OF THE SPANISH DRAMA.—Lectures and private reading. *Once a week; both semesters.*
Assistant Professor FITZ-GERALD.

Courses for Graduates and Advanced Undergraduates

11. THE SPANISH DRAMA OF THE SIXTEENTH AND SEVENTEENTH CENTURIES.—*Encina, Torres Naharro, Lope de Vega, Lope de Rueda, Tirso de Molina, Calderon, Ruiz de Alarcon, Moreto, Rojas Zorilla; Schack's Dramatic Literature. Three times a week; both semesters.*
Dr. SEYMOUR.

12. THE NOVELA OF THE GOLDEN AGE.—A study of the political and social conditions in Spain from 1560 to 1700 will be followed by an examination of the various kinds of prose fiction produced in this period, with special attention to *Don Quijote* and the *Novelas Ejemplares* of Cervantes. *Three times a week; both semesters.*
Assistant Professor FITZ-GERALD

ITALIAN

Courses for Graduates and Advanced Undergraduates

2. LITERARY COURSE.—First semester: Rapid reading from the works of the principal Italian writers of the nineteenth century. Second semester: Dante. The *Vita Nuova* and the *Inferno*. Selected stories from Boccaccio *Decameron. Twice a week; both semesters.*
Dr. JONES.

B. History and the Social Sciences

ECONOMICS

Every student entering upon graduate work in economics

must have had a thorough course in the principles of the science and should also have studied some special part of the field of economics, such as public finance or money and banking.

The department of economics includes general economics, economic history, finance, commerce and industry.

The library equipment of the department is one of the best in the country. Complete sets of all the important French, German, English, and American economic and financial journals are on hand, ninety periodicals, foreign and domestic, in economics, finance, commerce, industry, statistics, etc., are currently received. The department has recently purchased the duplicates of the collection of labor literature gathered by the Bureau of Industrial Research at Madison, Wisconsin. This collection, with what was already in the University library, affords a large amount of valuable material for original research. The library is unusually strong in railroad literature, economic history, finance and general theory.

Courses for Graduates

101. ECONOMIC THEORY.—*Twice a week; both semesters.* Professor KINLEY.

102. ADVANCED GENERAL ECONOMICS.—An advanced course covering the whole field with detailed discussion of certain parts. *Twice a week; both semesters.* Professor KINLEY.

[Not given in 1910-11.]

103. SEMINARY IN RAILWAY ADMINISTRATION.—Advanced students in this subject make an investigation of some aspect of railway administration. *Once a week; both semesters.* Professor DEWSNUP.

104. SEMINARY IN COMMERCE.—A study of present international commercial relations, with special reference to the trade conditions of the United States and the extension of her trade in foreign markets. *Once a week; both semesters.* Dr. LITMAN.

106. RAILWAY POLICY.—A study of various railway policies and problems in the United States and abroad. *Once a week; both semesters.* Professor DEWSNUP.

107. THE CORPORATION IN ECONOMIC EVOLUTION.—*Once a week; both semesters.* Professor ROBINSON.

108. COMPARATIVE CORPORATION ORGANIZATION.—*Once a week; both semesters.* Professor ROBINSON.

[Not given in 1910-11.]

118. SEMINARY.—The special subject of study for 1910-11

will be announced in due course. Professor KINLEY and others.

120. HISTORY OF ECONOMIC THOUGHT.—*Twice a week; both semesters.* Dr. THOMPSON.

122. ADVANCED ECONOMIC HISTORY OF THE UNITED STATES.—In this course an effort will be made to show the part which economic factors have played in the history of our country. The connection between economic and political movements will be noted, and careful studies will be made of particular phases of our economic history, such as the westward movement and the settlement of the public lands. The seminary method will be followed, and each student will prepare during the semester at least one thesis on an assigned topic which will be read and discussed in class. *Twice a week; both semesters.*

Associate Professor BOGART.

[Not given in 1910-11.]

Courses for Graduates and Advanced Undergraduates

4. FINANCIAL HISTORY OF THE UNITED STATES.—A study of colonial and federal finance, including currency, banking, tariff and fiscal questions and a brief survey of the development of the financial systems of some of the leading states, as New York and Illinois. *Three times a week; first semester.*

Assistant Professor WESTON.

[Not given in 1910-11]

5. PUBLIC FINANCE.—Public debts, revenue, taxation, etc. *Twice a week; both semesters.* Associate Professor BOGART.

10. CORPORATION MANAGEMENT AND FINANCE.—*Three times a week; first semester.* Professor ROBINSON.

11. INDUSTRIAL CONSOLIDATION.—The development of industrial consolidations; the growth of monopoly; monopoly prices and methods; the ability of trusts to affect prices, wages, interest, and profits; and the proposed plans for controlling trusts. *Three times a week; second semester.* Professor ROBINSON.

12. THE LABOR PROBLEM.—*Three times a week; both semesters.* Dr. TOWLES.

21. SOCIALISM AND SOCIAL REFORM.—*Three times a week; second semester.* Dr. TOWLES.

29. FOREIGN COMMERCE AND COMMERCIAL POLITICS.—A study of the various commercial systems, mercantile, free trade and protective, etc. *Three times a week; second semester.*

Dr. LITMAN.

31. HISTORY OF THE COMMERCIAL RELATIONS OF THE UNITED STATES.—This comprises a study of the general trade

relations of the United States with foreign countries as well as a more detailed consideration of our commercial relations with certain countries. It is desirable, though not required, that this course be taken in connection with 35. *Twice a week; second semester.* Dr. LITMAN.

35. CONSULAR AND DIPLOMATIC SERVICE.—The basis of this course is the consular and diplomatic relations of the United States. Some attention, however, is paid to the foreign service of other important countries. *Three times a week; second semester.* Dr. LITMAN.

43. TRAFFIC ADMINISTRATION.—The work of the freight and passenger traffic departments. *Three times a week; first semester.* Professor DEWSNUP.

44. RAILWAY TRANSPORTATION.—The train service, train dispatching and the block system of train working are emphasized. *Three times a week; second semester.* Professor DEWSNUP.

45. RAILWAY PRACTICE.—A study of the design of steam tracks, freight houses, and yards, with reference to economy and expedition of operation; methods of operation; fast freight service; car service and demurrage arrangements; the economics of railway location and operation. *Three times a week; first semester.* Professor DEWSNUP.

47. FOREIGN RAILWAY SYSTEMS.—A general study, each year, of some one foreign railway system. *Three times a week; second semester.* Professor DEWSNUP.

HISTORY

Advanced courses in history at the University of Illinois are of three kinds: 1. Instruction in methodology, historiography, and bibliography. This work is done at present by the co-operation of various instructors in course 103 described below, and is required of all graduate students in history during their first year. 2. Seminary courses for the study of special fields with a view primarily to training in the methods of historical criticism and research. 3. Courses for information and guidance in general reading.

Research or seminary work in history is offered in the following fields: American history with special reference to institutions and western development; English history with emphasis upon medieval institutions and the eighteenth century; modern European history with special reference to the rise of Prussia and the revolutionary and Napoleonic era; the history

of Latin America. Research topics in these special fields will commonly be arranged in cycles so that a new topic may be taken up in each of the three years devoted to graduate work.

A student entering upon graduate work should have had at least the equivalent of the introductory college courses in English, continental European, and American history. Emphasis is laid upon linguistic preparation. All historical students should have at least a reading knowledge of German and French; for medieval history some knowledge of Latin is indispensable, and in certain fields of American history Spanish is needed. The requisite reading knowledge of French and German should be secured before the student enters on his second year of graduate work.

As illustrating the resources of the library for historical purposes the following items may be noted: In American history there are strong collections of colonial and federal documents and of the writings of statesmen, and such periodicals as Niles' Register. As the result of recent acquisitions the collection is especially rich in contemporary material dealing with the American Revolution and the history of the west in the eighteenth century. In English history there are such standard sets as the Statutes of the Realm, the Parliamentary Debates, the Rools Series, the Calendars of State Papers, and the Reports of the Historical Manuscripts Commission. The library has also purchased recently some of the important collections in the field of Continental European history. A valuable addition to the resources of the department is the library of western history collected by the late Edward G. Mason, a former president of the Chicago Historical Society. This library now constitutes the Mason Collection of the Champaign Public Library. Attention is also called to the fact that the University of Illinois has for some time co-operated with the Illinois State Historical Society and the trustees of the State Historical Library, in the gathering and editing of archive material. As a result of this relation instructors and graduate students in the department have, from time to time, contributed to the publications of these state organizations, and have been given useful training in the study of manuscript as well as printed material.

As a means of mutual stimulus the Historical Club has been organized, consisting of instructors and graduate students in the department. The monthly program is devoted to reviews

of current progress in historical work and from time to time members report the results of their own investigations.

Courses for Graduates

101. Seminary in American History.—The work of this course consists partly of general exercises in which all the members of the class are expected to take part. In these exercises some attention will be given to the general bibliography of American history; but a large part of the time will be devoted to the co-operative study of typical problems. During the first semester of 1910-1911 these problems will be selected from the history of the American colonies in the seventeenth century; during the second semester the topics will be selected from the field of western history. At the option of the instructors and the students this course may also include the preparation of a thesis based upon the results of original research. *Two hours, once a week; both semesters.*

Professor Greene, Associate Professor Alvord.

102. Studies in English History.—The purpose of this course is to provide an opportunity for a closer study of some of the more important periods and movements of English history. The year 1910-1911 will be devoted to a study of social and political problems of the later middle ages. *Twice a week; both semesters.* Assistant Professor Larson.

103. Historical Bibliography and Criticism.—Selected problems in various fields are worked out under the guidance of the several instructors. Required of all candidates for an advanced degree in history who do not present evidence of similar training elsewhere. *Twice a week; both semesters.*

Dr. Paetow and others.

104. Seminary in Modern European History.—The subject selected for 1909-10 is the influence of the French Revolution in Germany. *Both semesters.* Professor Ford.

[Not given in 1910-11].

105. The History of Western Expansion, 1763-1818.—The period indicated is covered by lectures and readings, but the main object of the course is the study of various problems in the interpretation of western history. *Once a week; both semesters.* Associate Professor Alvord.

106 The Formation and Development of Brandenburg-Prussia from 1640 to 1786.—This course gives an opportunity, for somewhat detailed study of the work of the Great Elector

Frederick William I., and Frederick the Great. *Twice a week; both semesters.* Professor FORD.

107. SELECTED TOPICS IN THE HISTORY OF THE NINETEENTH CENTURY.—This course does not aim at a connected presentation of the whole period, but certain events, persons, and movements are selected for intensive study. Open to graduates and to qualified juniors and seniors on approval of the instructor. *Twice a week; both semesters.* Professor FORD.

108. FRENCH INSTITUTIONAL HISTORY DURING THE SEVENTEENTH AND EIGHTEENTH CENTURIES.—The gradual development of the institutions of the centralized government will be traced by means of a careful study of the fundamental laws. In a similar manner the methods adopted to promote economic development, particularly those concerned with commerce and colonial expansion, will be studied. *Twice a week; first semester.* Associate Professor ALVORD.

109. THE HISTORY OF THE FRENCH COLONIES IN AMERICA.—The history of French exploration and settlement in America will be studied, as far as possible, in the primary sources. Particular attention will be given to the French colonial institutions and to the discovery and colonization of the Mississippi Valley. *Twice a week; second semester.* Associate Professor ALVORD.

110. THE SPANISH-AMERICAN REVOLUTION.—A detailed study of the movement which culminated in the independence of the Spanish-American states. *Two hours, once a week; first semester.* Assistant Professor ROBERTSON.

111. THE SPANISH-AMERICAN DIPLOMACY.—A consideration of the problems which have arisen in the relations of the leading Spanish-American states withEurope and the United States. *Two hours, once a week; second semester.* Assistant Professor ROBERTSON.

History 110 and 111 are open only to students who possess a reading knowledge of the Spanish language.

112. SELECTED TOPICS IN THE HISTORY OF THE AMERICAN COLONIES IN THE EIGHTEENTH CENTURY.—The special subject selected this year is a study of American society on the eve of the Revolution. *Two hours, once a week; second semester.* Professor GREENE.

Courses for Graduates and Advanced Undergraduates

(The ability to use French and German is desirable in most of these courses and is essental in some of them).

4. Constitutional History of England.—During the first semester, the emphasis is placed on institutional origins; in the second semester particular attention is given to modern constitutional practice. *Three times a week; both semesters.*

Assistant Professor Larson.

8. Medieval Culture.—The main object of this course is to trace the intellectual development of medieval civilization. In the period of transition from pagan to Christian culture typical figures like St. Augustine, Boethius, and Gregory the Great are studied in some detail. In the twelfth and thirteenth centuries prominence is given such topics as the strife over investitures, the crusades, vernacular literature, development of Gothic architecture, rise of universities, and scholasticism. *Three times a week; first semester.* Dr. Paetow.

9. The Era of the Renaissance.—This course deals with the political, religious, and economic history of Europe during the fourteenth and fifteenth centuries as well as the intellectual and artistic revival. It is designed to be a continuation of course 8, although either may be taken separately. *Three times a week; second semester.* Dr. Paetow.

13. American Revolution, 1760-1783.—The following topics will be considered: The American people and their institution at the close of the colonial era; the causes of the Revolution, 1760-1775; a survey of the war period, 1775-1783, with special emphasis on the economic, social, and political changes, rather than upon military and diplomatic transactions. *Three times a week; first semester.* Professor Greene.

[Not given in 1910–11.]

14. The Making of the Federal Constitution.—This course provides for an intensive study, based upon original material, of the events from 1783–1789, which resulted in the framing and ratification of the federal convention of 1787 and the contemporary arguments for and against the ratification of the Constitution. *Three times a week; first semester.*

Professor Greene.

15. The Civil War and the Reconstruction of the Southern States.—This course begins with a careful study of life and institutions in various sections of the country just before the secession of the southern states. In the treatment of the civil war, stress is laid upon political and economic conditions rather than upon military campaigns. In the treatment

of the reconstruction period, emphasis is laid upon southern conditions. *Three times a week; second semester.*

Professor GREENE.

22. AMERICAN HISTORY, 1820–1860.—An intensive study of the period including social as well as political history. *Three times a week; second semester;* Professor GREENE.

[Not given in 1910–11.]

26. THE MODERN HISTORY OF SPAIN.—A rapid survey of the early history of Spain, followed by a closer study of the modern period. This course is intended to furnish a background for the study of Spanish colonization in America. *Three times a week; first semester.* Assistant Professor ROBERTSON.

27. THE HISTORY OF LATIN AMERICA AND THE PHILIPPINES.—During the first semester the topics covered will be as follows: The discovery and exploration of the New World; the settlement, administration, and civilization of the Latin-American colonies; the struggles for independence. During the second semester the course will include a survey of the national history of the leading Latin-American states with special attention to political parties, existing governments, and relation with the United States. *Three times a week; both semesters.*

Assistant Professor ROBERTSON.

POLITICAL SCIENCE

Graduate work in political science embraces the following special fields: (1) Comparative Government; (2) Public Administration and Administrative Laws; (3) International Law and Diplomacy; (4) Constitutional Law; and (5) Political Theory.

No student is considered qualified to carry graduate work in political science who has not had at least the equivalent of the introductory college courses in government and history. A reading knowledge of German and French is highly desirable and in some of the courses it is indispensable. Attention is called to the fact that recently extensive additions to the library equipment have been made so that the facilities for research work in political science are now believed to be ample for ordinary purposes.

Courses for Graduates

101. MUNICIPAL ADMINISTRATION.—This is an advanced course dealing in the first semester, with the development of cities, the organization of municipal government and its relation

to the central government, and political methods and reform movements in cities. Comparison is made between conditions in the United States and European countries and recent tendencies in this country discussed.

In the second semester, an examination is made of municipal functions in the United States and Europe, including police, fire, and health departments, schools, and charities, municipal public works, street railways, lighting plants, etc. The work of each semester may be taken independently of the other. *Three times a week; both semesters.* Associate Professor FAIRLIE.

102. THE NATURE OF THE STATE.—The principles, methods, and relations of political science; the origin, nature, forms, and functions of the state; sovereignty and liberty; citizenship and nationality; constitutions, principles of political organization, etc. *Twice a week; first semester.* Professor GARNER.

103. SEMINAR IN POLITICAL SCIENCE AND PUBLIC LAW.—Research work in the investigation of special problems. Presentation of reports followed by discussion and criticism. The research work of candidates who are writing these will be under the personal supervision of some individual instructor to whom the candidates will be expected to report from time to time. *Both semesters.* Professor GARNER.

Courses for Graduates and Advanced Undergraduates

2a. BRITISH GOVERNMENT.—Political institutions in the United Kingdom and the British Possessions, including the Crown, the Cabinet, the House of Commons, and the House of Lords, the party system, the courts of law, local government, and government in the Crown Colonies and the self-governing colonies. Attention will be given to recent developments and proposed changes. Open to graduate students and to seniors who have had six hours in political science. *Three times a week; first semester.* Associate Professor FAIRLIE.

2b. CONTINENTAL EUROPEAN GOVERNMENT.—A comparative study of the national political system of France, Germany, Italy, Austria-Hungary and Switzerland, with special reference to constitutional beginnings, political organization, methods of legislation and administration, and constitutional guarantees for the protection of individual rights. *Three times a week; second semester.* Professor GARNER.

5. THE FEDERAL CONSTITUTION.—An exposition and analysis of the federal system of the United States through a

study of the origin and nature of the federal constitution and its development through judicial interpretation. The constitution in its relation to the geographical divisions of the United States; the jurisdiction of the federal courts; state and national citizenship; the powers of the national government and constitutional limitations on those of the states; the effect of later amendments on the federal system. Study of leading cases supplemented by the text book work and lectures. *Three times a week; first semester.* Dr. DODD.

6. INTERNATIONAL LAW.—The development of the law of nations; its nature, source, and present status; the equality of states; the doctrine of intervention; the law of war and peace; the rights and duties of neutrals; the arbitration movement. Lectures, assigned reading and reports. *Three times a week; first semester.* Professor GARNER.

7. AMERICAN DIPLOMACY.—A study of genesis and present organization of the Department of State; the diplomatic service; the treaty making power; the methods and traditional principles of the foreign policy of the United States; historical review of the principal diplomatic controversies between the United States and foreign powers from the foundation of the government to the present time; the rise of the United States to the position of a world power. *Twice a week; second semester.* Professor GARNER.

8. COLONIAL ADMINSTRATION.—A study of the principal systems of colonial adminstration, notably those of Great Britian, France, The Netherlands and the United States, including a historical survey of the policy of the countries in dealing with their more important dependencies. *Twice a week; first semester.* Dr DODD.

10. ADMINISTRATIVE LAW.—The nature of administrative law and its relation to constitutional law; the principle of separation powers as a rule of law; judicial control over administrative officials; legal powers and liabilities of public corporations as administrative authorities. Study of cases, text book work, and lectures. *Three times a week; second semester.* Dr. DODD.

11. THE POLICE POWER.—The nature and limits of the police power. The activity of the state in the interests of the general welfare through the regulation of the use of liberty and property. Legislation for the protection of the public safety, the public health, and the public morals. It is recommended

that this course be preceded by Course 5. *Twice a week; second semester.* Dr. DODD.

12. NATIONAL ADMINISTRATION IN THE UNITED STATES.—A study of the President and Congress; the executive departments and the administrative services of the national government, including a survey of judicial administration and the relation of the courts to the administrative authorities. *Three times a week; first semester.* Associate Professor FAIRLIE.

13. STATE AND LOCAL ADMINISTRATION IN THE UNITED STATES.—A study of the administrative powers of the state executive and legislature, of the state officers and institutions, and the system of local government, including the relations between the state and local authorities and between the courts and administrative officials. *Three times a week; second semester.* [Not given in 1910–11]. Associate Professor FAIRLIE.

14. POLITICAL PARTIES.—A study of the development of political parties and their organization and influence on the government mainly in Great Britain and the United States, with attention to recent legislation in primaries and nomination methods in this country. *Twice a week; first semester.* Associate Professor FAIRLIE.

15. POLITICAL PHILOSOPHY.—Philosophical theories of the state, historical, critical, constructive. *Twice a week; second semester.* Mr. BECKER.

See Philosophy 5.

SOCIOLOGY

Preparation for graduate work in sociology should include the principles of economics and psychology, together with history. Unless the undergraduate preparation has also included the subject matter treated in one or more of the courses numbered 1, 2, 3 and 4, none of those courses may be omitted by a graduate student whose major subject is sociology.

Courses for Graduates

101. SOCIOLOGICAL METHOD.—A study of the method of advancing the science of sociology, including a discussion of the adaptability to sociological investigation of the methods described in certain important works on methodology, for example, Pearson's Grammar of Science, Wundt's Methodenlehre, erster

und vierter Abschnitt, Seignobos' La Methode Appliquée aux Sciences Sociale. *Three times a week; first semester.*

Professor HAYES.

[Not given in 1910–11]

102. THE DEVELOPMENT OF SOCIOLOGY,—A reading course in the original works of the writers who have contributed most to the development of sociology, accompanied by discussions with the instructor. *Twice a week; both semesters.*

Professor HAYES.

150. SEMINARY.—The subjects pursued in seminary vary from year to year. The chief aim is to develop initiative and skill on the part of the students themselves, in the matters of investigation. *One session of two hours once in two weeks; both semesters.* Professor HAYES.

Courses for Graduates and Advanced Undergraduates

1. GENERAL SOCIOLOGY.—Essential points of view involved in the application of scientific method to social interpretation, and certain fundamental concepts and main teachings of sociology. *Three times a week; first semester.* Professor HAYES.

2. SOCIAL CONTROL AND SOCIOLOGICAL ETHICS.—An explanation of the methods by which society controls the conduct, beliefs, and desires of its members, by law, religion, education, public opinion, and other agencies; together with a study of the rational motives of conduct. *Twice a week; second semester.*

Professor HAYES.

3. COMPARATIVE AND GENETIC SOCIOLOGY.—A course for students who desire acquaintance with the comparative or "ethnological" method of dealing with questions of theory in the social sciences; presenting a body of facts concerning social activities (economic, political, legal, ethical, religious, domestic, etc.) as they prevail or have prevailed among people at different stages of progress, savage, barbarous and civilized, with inductions from such facts including a theory of social evolution, and of the method of progress. *Twice a week; first semester.*

Professor HAYES.

4. PSYCHOLOGICAL SOCIOLOGY.—The conditioning of social activities by each other; public opinion, public sentiment, leadership, mobs, fashions, custom, conventionality, periods of social productivity and decay, etc. *Three times a week; second semester.* Professor HAYES.

[Not given in 1910–11]

5. Charities and Corrections.—The causes, prevention, and treatment of poverty and crime. *Three times a week; second semester.* Professor Hayes.

12. The Labor Problem.—Courses 12 and 21 are Economics 12 and 21 and, when taken by students whose major is economics or sociology, must be counted in their major department. *Three times a week; both semesters.* Dr. Towles.

21. Socialism and Social Reform.—*Three times a week; second semester.* Dr. Towles.

C. Education Philosophy and Psychology.

EDUCATION.

Graduate students who elect education as a major subject must have completed the following undergraduate courses or their equivalents: Education 1 and 2, and at least three hours in psychology and three hours in philosophy. In the case of graduate students who have had experience in teaching, these requirements may be modified.

Courses for Graduates

101. Seminary.—*Both semesters.* Professor Bagley, Assistant Professor Anderson.

111. Practice-Teaching.—Students who desire to enroll in this course must present, from the head of the University department representing the subject that they propose to teach, satisfactory evidence that they are qualified from the standpoint of subject-matter. Each graduate student taking this course must select, with the approval of the Department of Education, some problem of teaching or management upon which there is a division of opinion among educators, plan means for investigating this problem, and present a written report of his methods and results before the close of the term. *Five times a week; first or second semester.* Professor Bagley, Dr. Norton.

Courses for Graduates and Advanced Undergraduates

4. Contemporary Educational Conditions and Movements in the United States.—The interpretation of present tendencies as exemplified in the school systems of typical cities and states and in recent educational experiments in administration, discipline, methods, and subject matter. *Twice a week; first semester.* Dr. Norton.

5. Comparative Study of the Secondary Schools of France, Germany, England, and the United States.—The different types of secondary schools in each country; conditions of their origin and development; their present status and relation to elementary schools and universities. *Twice a week; second semester.* Dr. Norton.

6. Principles of Secondary Education.—High school organization and management. A discussion of the essential elements of a high school, together with a consideration of the conditions existing in Illinois. Especial attention is given to the educational values of the studies represented in the secondary curriculum, to the structure of the course of study, and to the technique of secondary teaching and management. *Three times a week; second semester.* Professor Bagley, Assistant Professor Hollister and special lecturers.

7. History of Industrial and Vocational Education.—Industry and industrial training in Egypt, Greece, Rome; industry and industrial training in the Middle Ages; the industrial revolution and its effect upon education; recent tendencies in the development of agricultural and industrial high schools, agricultural colleges, monotechnic schools, continuation schools, etc. *Twice a week; second semester.* Assistant Professor Anderson.

13. Educational Classics.—A critical study of the sources of the history of education. The more important educational works of Plato, Aristotle, Quintilian, Montaigne, Milton, Locke, Rosseau, Pestalozzi, Herbart, Froebel, Spencer, and others are considered. *Three timee a week; first semester.* Dr. Norton.

17. Herbartian Pedagogics.—The philosophy, psychology, and pedagogy of Herbart are critically studied and compared with other pedagogical systems. *Twice a week; first semester.* Dr. Norton.

18. Principles of Esthetic, Moral, and Religious Education.—Values, ideals, and methods of each; their relation to each other, to intellectual training, and to the utilities of life; their effects on social and national life and on the general advancement of the fine arts; selection of the material of instruction, and the development of individual taste and conscience; the public school, the Sunday school, and other instrumentalities. *Three times a week; first semester.* Dr. Norton.

20. Philosophy of Education.—*Three times a week; first semester.*

20a. Theory of Supervision.—A study of the problems of

supervision with especial reference to the training and improvement of teachers. Open only to graduate students, to seniors who are either graduates of normal schools or experienced teachers, and to seniors who are preparing for the work of supervision in special subjects, such as household science, manual training, and physical training. *Second semester.*

Professor BAGLEY.

20b. THEORY AND PRACTICE OF SUPERVISION.—Course with the addition of a period of actual practice in the constructive criticism of teaching. *Second semester.* Professor BAGLEY.

PHILOSOPHY

Students entering upon graduate work in philosophy should have had at least one course in the history of the subject, and one in psychology.

Courses for Graduates

101. THE PHILOSOPHY OF PLATO AND ARISTOTLE.—*Twice a week; both semesters.* Professor DANIELS.

102. SEMINARY.—Contemporary Philosophy. A study of present day idealism, realism, and pragmatism. *Twice a week; both semesters.* Professor BODE.

Courses for Graduates and Advanced Undergraduates

7. ETHICS.—The beginnings and growth of morality; analysis and criticism of the leading conceptions of moral theory; discussion of some of the typical social and economic problems of the present. *Three times a week; first semester.* Professor DANIELS.

8. ESTHETICS.--Theory of the appreciation of art and nature; place of such appreciation in life. (a) Primitive arts and appreciation. (b) Modifications of the esthetic (such as the sublime and the ugly). (c) Prime characteristics and relations of the various fine arts. *Three times a week; first semester.* Dr. NORTON.

11. HISTORY AND PHILOSOPHY OF RELIGION.—An historical and comparative study of religions. The philosophical interpretations of religious consciousness and a critical study of various religious concepts; God, revelation, inspiration, dogma, faith, prayer, immortality, the problem of evil, the relation of morality and religion. *Twice a week; both semesters.* Professor DANIELS.

15. THE BRITISH PHILOSOPHERS OF THE EIGHTEENTH CENTURY.—Locke, Berkeley and Hume. *Three times a week; first semester.* Professor BODE.

16. KANT.—The Critique of Pure Reason. *Twice a week; second semester.* Professor BODE.

PSYCHOLOGY

No student may do graduate work in psychology without having had courses 1 and 7, (elementary psychology), or their equivalent, and at least one three-hour course in philosophy.

Courses for Graduates

101. RESEARCH.—Opportunity to investigate advanced problems in experimental psychology, and in comparative and genetic psychology is offered to properly qualified graduate students. *Both semesters.*

102. CONTEMPORARY LITERATURE.—The most important problems of contemporary psychology, with their historical bearings, will be presented and discussed. *Twice a week; both semesters.* Professor COLVIN.

111. THE PSYCHOLOGY OF THE INTELLECTUAL PROCESSES. —*Twice a week; second semester.*

113. ABNORMAL PSYCHOLOGY.—The pathological aspects of consciousness; arrested mental development in children and mental disorders in later life. *Twice a week; second semester.* Dr. SUTHERLAND.

114. THE PSYCHOLOGY OF MEMORY.—Two lectures a week and two hours of laboratory demonstration. *Three times a week; first semester.*

Courses for Graduates and Advanced Undergraduates

3. EXPERIMENTAL PSYCHOLOGY.—The object of this course is to train the student in laboratory methods, and to give him an intimate acquaintance with normal phenomena. *Twice a week; first semester.* Dr. SUTHERLAND.

4. EXPERIMENTAL PSYCHOLOGY.—This course is a continuation of Course 3 and cannot be elected separately. *Twice a week; second semester.* Dr. SUTHERLAND.

5. GENETIC PSYCHOLOGY.—This course traces the mental development of the child from birth to maturity. The latter part is devoted to the phenomena of adolescence, and the intellectual problems confronting the youth. The development of the nervous system and growth of the body are traced in connection with the mental development. *Twice a week; second semester.* Professor COLVIN.

6. Comparative Psychology.—This course aims at an analysis of animal behavior and its interpretation. *Twice a week; first semester.* Dr. Sutherland.

9. Physiological Psychology.—This course deals with the physiology and psychology of the central nervous system and of the sense organ. Lectures and laboratory periods. *Twice a week; second semester.* Dr. Sutherland.

12. Minor Problems in Experimental Psychology.—This is an advanced laboratory course in which special investigations are undertaken by advanced undergraduate students. *Two to five times a week; both semesters.*

Professor Colvin, Dr. Sutherland.

D. The Physical Sciences, Including Mathematics.

ASTRONOMY

Courses for Graduates

101. Seminary.—The work offered to graduate students is largely governed by the preparation and abilities of different individuals. *Three times a week; both semesters.*

Assistant Professor Stebbins.

Courses for Graduates and Advanced Undergraduates.

7. Theoretical Astronomy.—This course begins with the elementary theory of the motions of the heavenly bodies, and is intended to lead the student up to the actual computation of a cometary orbit. *Three times a week; both semesters.* Dr. Reed.

9. Celestial Mechanics.—A continuation of course 7. Introduction to the theory of disturbed planetary motion. *Three times a week; both semesters.* Dr. Reed.

14. Observational Astronomy.—This course is intended for those who wish to become familiar with the working methods of an astronomical observatory. The problems set for solution are largely individual. *Three times a week; second semester.*

Assistant Professor Stebbins.

15. Geodetic Astronomy.—Advanced work with the sextant, transit, and zenith telescope. *Three times a week; first semester.* Assistant Professor Stebbins.

CHEMISTRY

Graduate students whose major subject is in some other department than chemistry, before taking graduate work for

credit in this department must have had the equivalent of 15 University credits in chemistry, and the work covered must have included satisfactory work in general chemistry and in qualitative and quantitative analysis. Such students are advised to take Chemistry 31, 33, 102, 102a, 5b, 5c, 14, and 9a and b. Courses of a more special nature will not, as a rule, be accepted for graduate work unless preceded by one of the above courses.

For students in agriculture 5a and 13a will not be accepted for graduate credits.

Graduate students who are candidates for an advanced degree in chemistry must have had the equivalent of 30 University credits in chemistry, and this must include satisfactory courses in general chemistry, qualitative and quantitative analysis, physical chemistry, and organic chemistry. Before receiving the degree of Doctor of Philosophy such students will be expected to complete work equivalent to courses 31, 33 (or 102 and 102a) 14, 9a, 9b, 101, and 111. They are advised to take at least brief courses in gas analysis, iron, and steel analysis, water analysis, assaying, and chemical technology.

For students in chemistry, 5a, 13a, 9 and 9c will not be accepted for graduate credit and 9a, 9b, 14. 31 and 33 will be accepted only from students entering the Graduate School with the equivalent of 30 University credits in chemistry.

Courses for Graduates

101. History and Theories of Chemistry.—A discussion of the historical development of the science of chemistry. *Twice a week; first semester.* Dr. Smith.

102. Advanced Physical Chemistry.—This course will be conducted on the seminar plan and, together with 102a. is intended to cover a period of two years. The subject is treated from the standpoint of *Avogadro's Principle and Thermodynamics* and the course is based primarily upon *Nernst's Theoretische Chemie.* The primary purpose of this course is to develop power to handle successfully a physico-chemical problem rather than to merely impart a knowledge of the phenomena and the principles involved.

Text-books: *A. A. Noyes's General Principles of Physical Science, Nernst's Theoretische Chemie, 6th edition,* or the translation of the 4th edition. *Twice a week; both semesters.* Dr. Washburn.

102a. Advanced Physical Chemistry.—A continuation of course 102. The following topics will be considered in this part of the course. The physical properties of chemical substance, the Phase Rule, certain portions of thermochemistry, photochemistry, the thermodynamics of electrochemistry, radioactivity and the atomistic theory of electricity. This course alternates with course 102. Text-books: *Nernst's Theoretische Chemie. Twice a week; both semesters.* Dr. Washburn.

[Not given in 1910-11]

102b. Advanced Electrochemistry.—This course deals with the modern theories of solution and the principles of thermodynamics in their application to the problems of electrochemistry. The subjects of electrolytic conductivity and transference, electromotive force, and the energy principles underlying the transformations of chemical and electrical energy are discussed in detail. The recent advances in the electrolysis of fused electrolytes and the applications of electricity to gaseous reactions at high temperatures will also be dealt with. Text-book: *LeBlanc's Electrochemistry.* This course is also open to undergraduates having the necessary preparation. *Three times a week; second semester.* Dr. Jones.

102c. Advanced Physical and Electrochemistry.—A laboratory course dealing with the applications of physico-chemical methods to special problems. The nature of the experiments performed by the student will depend upon his previous training in this subject and his purpose in taking the course. The experiments are designed to develop the power of independent thinking in applying physico-chemical methods to problems in the laboratory. This course must be preceded or accompanied by courses 102, 102a or 102b. *Twice a week; both semesters.* Dr. Washburn, Dr. Jones.

102e. Special Topics in Physical Chemistry.—A detailed study of certain branches of physical chemistry and its applications will be taken up in this course. The course will be presented on the seminar plan and the topics considered will vary from year to year. Subject for 1910-11:—Capillary Chemistry and the Chemistry of Colloids. Text-books: *Breundlich's Kapillarchemie, Ostwald's Grundriss der Kolloidchemie. Once a week; first semester.* Dr. Washburn.

103. Advanced Inorganic Chemistry.—A systematic presentation of descriptive inorganic chemistry, including the rarer elements and based on the periodic system. The work

consists of two lectures a week throughout the year, which may or may not be accompanied by laboratory work on advanced inorganic preparations. *Two to five times a week; both semesters.*

Dr. BALKE.

103a. ADVANCED ANALYTICAL CHEMISTRY.—This course is designed for students who may desire to take advanced work in either qualitative or quantitative analysis. The lectures will deal with special topics in analytical chemistry. *One to five times a week; second semester.* Dr. HOLMES.

104. ADVANCED ORGANIC CHEMISTRY.—Special chapters. This course consists of two lectures a week with assigned reading and is especially recommended to students doing research work in this subject. Special attention is given to the detailed study of recent research methods in such fields as: Condensation, carbohydrates, fermentation, and enzyme action, the purine group, the proteins, isomeric change, stereochemistry of nitrogen, the relation of color to chemical constitution, alkaloids, etc. The chapters may be varied from year to year. *Twice a week; first semester.* Assistant Professor CURTISS.

105. ADVANCED PHYSIOLOGICAL CHEMISTRY.—This course consists of lectures, conferences, and demonstrations, and embraces selected portions of physiological chemistry which are not covered by Chemistry 15. The course is open to graduates or undergraduates. *Twice a week; second semester.* Professor HAWK.

106. ANIMAL CHEMISTRY.—A lecture course consisting of a critical study of the recent advances in the chemistry of nutrition of the lower animals, and a detailed study of the chemistry of the functional products, such as flesh, fat, milk, wool, etc., of the more common domesticated animals. *Twice a week; both semesters.* Professor GRINDLEY.

107. CALORIMETRY OF FUELS.—An advanced course in the study of methods for determining the heat values of solid, liquid, and gaseous fuels. *One to three times a week; both semesters.*

Professor PARR.

108. WATER SUPPLIES.—A study of the sources of contamination of water supplies and the purification of water for potable or technical use. *Five times a week; both semesters.*

Professor BARTOW.

PHYSICAL AND ELECTROCHEMISTRY.—Dr. WASHBURN.

INORGANIC CHEMISTRY.—Dr. BALKE.

ANALYTICAL CHEMISTRY.—Dr. HOLMES.

ORGANIC CHEMISTRY.—Professor NOYES.

SANITARY CHEMISTRY.—Professor BARTOW.
ANIMAL CHEMISTRY.—Professor GRINDLEY.
PHYSIOLOGICAL CHEMISTRY.—Professor HAWK.
INDUSTRIAL CHEMISTRY.—Professor PARR.

Courses for Graduates and Advanced Undergraduates

5c. FOOD ANALYSIS.—This course includes the analysis of food stuffs, grain, milled products, alcoholic beverages, baking powders, vinegars, syrups, sugars, etc. Students who have taken work amounting to five hours' credit in this course may arrange to do more advanced work along the following lines: (a) the study of methods for detecting food adulteration; (b) the separation and determination of the nitrogenous constituents of animal and vegetable foods; (c) the identification and estimation of the carbohydrate constituents of food products. *Three to five times a week; second semester.* Dr. HOLMES.

6. CHEMICAL TECHNOLOGY.—This is a course of lectures comprising a study of technological chemistry as illustrated in those industries having a chemical basis for their principal operations and processes. Much use is made of the journals. *Thorp's Industrial Chemistry* is used as a guide. No laboratory work. *Twice a week; second semester.* Professor PARR.

7. METALLURGY.—A general course in metallurgical processes. Lectures and assigned reading. *Twice a week; first semester.* Professor PARR.

8. IRON AND STEEL ANALYSIS.—Analyses are made of all the constituents by both rapid or technical, and standard methods. *Three times a week; second semester.* Dr. BURGESS.

9a. ORGANIC SYNTHESIS.—Laboratory work for students of the chemical course, in ultimate organic analysis and the preparation and study of typical organic compounds, to accompany Chemistry 14. *Twice a week; first semester.*
Assistant Professor CURTISS.

9b. ORGANIC SYNTHESIS AND ANALYSIS.—Continuation of 9a, to accompany Chemistry 14. *Twice a week; second semester.*
Assistant Professor CURTISS.

10a. WATER ANALYSIS.—Lectures on history, sources, contamination, and standards of purity of potable waters and waters for industrial purposes, together with practice in analytical methods. *Twice a week; first semester.* Professor BARTOW.

13b. ADVANCED AGRICULTURAL ANALYSIS.—This course is offered to students who wish to specialize in agricultural chem-

istry or agricultural experimentation. The work includes the analysis of butter and cheese, the complete analysis of foods, soils, and plants, plant ash, rain and drain waters, and the determination of the fuel value of foods. If desirable, the work may be varied to meet the special needs of the individual student. *Three to five times a week; second semester.* Dr. HOLMES.

14. ORGANIC CHEMISTRY.—This course consists of lectures and recitations upon the fundamental principles and more important compounds of organic chemistry. *Noyes's Organic Chemistry.* This course must be accompanied by Chemistry 9a and 9b. *Three times a week; both semesters.* Professor NOYES.

15. PHYSIOLOGICAL CHEMISTRY.—This course was designed especially for students desiring a fundamental knowledge of the principles of physiological chemistry. It will consist of lectures, demonstrations, conferences and practical work. The course will include a systematic study of enzymes; carbohydrates; salivary digestion; gastric digestion; fats, pancreatic digestion; intestinal digestion; bile; putrefaction products; feces; blood; milk; epithelial and connective tissue; nervous tissue and urine. The work on gastric juice, blood, urine, and milk will be both qualitative and quantitative, and all the clinical aspects of these topics will be treated thoroughly for the benefit of prospective students of medicine. The course is open to graduates and undergraduates. Books used: *Hammersten's Text Book of Physiological Chemistry*; *Hawk's Practical Physiological Chemistry.* *Five times a week; first semester.* Professor HAWK, Mr. HOWE.

17. TEACHER'S COURSE.—A study of the methods which may be followed in teaching elementary chemistry. *Once a week; first semester.* Dr. BALKE.

18. SPECIAL COURSES.—Special courses as indicated below, consisting mainly of laboratory work, may be arranged for those competent to pursue them. From 1 to 10 hours' credit will be allowed in the undergraduate courses for such work.

(a) Special problems in assaying and ore treatment. Free-milling chlorination and cyanide tests. Professor PARR.

(b) Advanced metallurgical chemistry. Professor PARR.

(c) Analysis and calorimetry of fuels. Professor PARR.

(d) Paints, oils, etc. Protective coverings for wood and iron. Professor PARR.

(e) Analysis of commercial fertilizers. Dr. HOLMES.

21. PROXIMATE ORGANIC ANALYSIS.—A course of laboratory practice, for advanced students, in systematic methods for

the identification of organic compounds and a study of organic mixtures as found in commercial articles. *Twice a week; first semester.* Mr. Derick.

22. Animal Chemistry.—A course for the detailed study of the chemical composition of animal products and feeding stuffs. This is a combined classroom and laboratory course. *Three to five times a week; first or second semester.*

Professor Grindley.

27. Qualitative Analysis of the Rare Elements.—A detailed study of the rare elements and their compounds. The work consists mainly in the identification and separation of the elements and the study of formation, solubilities, and chemical reactions of their salts. Reading is assigned in connection with laboratory work. *Three times a week; second semester.* Dr. Balke.

31. Elementary Physical Chemistry.—This course is designed to present, in an elementary manner, some of the more important principles and methods of physical chemistry and electrochemistry. Instruction is by lectures and recitations. To secure familiarity in appying the laws and principles of physical chemistry to practical problems in other branches of chemistry, the student is expected to solve numerous problems in connection with this course. *Walker's Introduction to Physical Chemistry. Three times a week; second semester.* Dr. Washburn.

33a. Elementary Physical Chemistry.—A laboratory course to accompany course 31. The experiments performed will include, the methods of determining molecular weight both in the gaseous state and in solution; the application of the principles relating to chemical equilibrium; the measurement of the electrical conductivity of solutions and the application of this property in interpreting the phenomena occurring within the solution; and the illustration of some of the fundamental conceptions of thermochemistry. *Twice a week; second semester.*

Dr. Washburn, Dr. Jones.

35. Electrochemistry.—Recitations or lectures and laboratory work dealing with the practical applications of electrochemistry in the industries; intended for students going into technical work. The study of patents is made an important feature of the course, each student being required to collect, study and report upon the more important patents in some selected industry. *Blount's Practical Electrochemistry.* See also Chemistry 102b. *Three to five times a week; first semester.*

Dr. Jones.

INORGANIC PREPARATIONS.—A laboratory course in the preparation of chemical products from raw materials. The manufacture and testing of pure chemicals, fractionation, and other processes of the manufacturing chemist. *Twice a week; second semester.* Dr. JESSE.

65.—TECHNICAL GAS AND FUEL ANALYSIS.—Examination of gases, gas mixtures, flue gases, and fuel. Determination of calorific values and calculation of efficiencies. *Twice a week; first semester.* Professor PARR, Dr. JESSE.

66.—EXACT GAS ANALYSIS.—A laboratory and lecture course on the analysis of commonly occuring gaseous mixtures, involving the use of the Hempel apparatus, measuring gases under constant pressure and constant volume and determination of the density of gases. *Twice a week; second semester.* Dr. ISHAM

68a. ANALYSIS OF GLASSES AND GLAZES.—For students in ceramics. A study of methods and practice on special problems connected with the pottery industry. *Three times a week; first semester.* Dr. HOLMES.

68b. CEMENT CHEMISTRY.—For students in ceramic engineering. This course includes the analysis of cements, cement materials, pottery, bodies, etc. *Three times a week; first semester.* Dr. HOLMES.

69. ASSAYING.—The fire assay of lead, gold, and silver ores. Fluxes, reagents, and charges are studied in connection with various typical ores, and practice given in use of the crucible and muffle furnaces and in the manipulations connected with fire assaying. *Twice a week; first semester.* Professor PARR, Dr. JESSE.

93. JOURNAL MEETING.—For juniors, seniors, and graduates. *Once a week; both semesters.* All members of the teaching staff in the Chemical Department.

GEOLOGY

Courses for Graduates

101. ADVANCED CRYSTALLOGRAPHY.—This course is intended to familiarize the student in chemistry or mineralogy with the methods used in measuring, projecting and calculating crystal forms, and in determining the physical properties of crystallized bodies. It includes determination of indices of refraction, electrical properties, morphotropism, etc. *Three to five times a week; first or second semesters.*

Associate Professor BAYLEY.

102. PETROGRAPHY.—Lectures and laboratory work on the

igneous rocks including identification of types, classification and relationships. *Two hours five times a week; first semester.*

Associate Professor BAYLEY.

103. PETROGRAPHY.—A continuation of Course 102 in which schists and sedimentary rocks become the object of study. *Two hours, five time a week; second semester.*

Associate Professor BAYLEY.

105. STRATIGRAPHIC PALEONTOLOGY.—A course devoted to the study of literature and the fossils of a special geological system; their geographic distribution; the geologic provinces; and the origin and the routes of migration of the different faunas during the period. Largely individual work. *Two to five times a week; first or second semester.* Assistant Professor SAVAGE.

106. FIELD AND LABORATORY COURSE.—A course consisting of a systematic study of a selected area in Jackson and Union counties, Illinois. A carefully prepared report on the geology of the region, based on the data collected in the field, is required. *Two to five times a week; first or second semester.*

Assistant Professor SAVAGE.

Courses for Graduates and Advanced Undergraduates

6. PHYSICAL AND OPTICAL MINERALOGY.—A direct introduction to the course in Petrography. The physical and opitical properties of minerals are discussed in lectures and studied in the laboratory, with special reference to their relations with respect to symmetry. The larger portion of the work is devoted to the study of polarized light and its practical use in identifying the rock-form materials. *Two hours, five times a week; second semester.* Associate Professor BAYLEY.

7. PETROGRAPHY.—The principles learned in Course 6 are applied to the study of rocks. Lectures describe the different types of these rocks and discuss their origin and classification. In the laboratory a representative suite of specimens is studied in the hand specimen and thin section. *Two hours, five times a week; first semester.* Associate Professor BAYLEY.

9. PALEONTOLOGY.—A study of invertebrate fossils, their classification and relationship, their succession in the rocks, and their geographic distribution. Instruction is given in the identification of the fossils, and in the finding and use of the literature of the subject. *Two hours, five times a week; first semester.*

Dr. BAGG.

16. STRATIGRAPHY.—This course follows course 9, and is a

study of principles of classification and nomenclature of rock formations, of the methods and criteria employed in correlation, of the characteristic faunas and floras of the successive geologic formations and their distribution, and of the relation of these to the interpretation of stratigraphy. Lectures and laboratory. *Two hours, five times a week; second semester.*

Assistant Professor SAVAGE.

17. STRATIGRAPHIC GEOLOGY.—A study of the distribution of the strata of the successive geological systems, the character of the sediments which compose them, and the interpretation of these deposits and their distribution in their relation to paleo-geography. *Five times a week; second semester.*

Assistant Professor SAVAGE.

18. MESOZOIC AND TERTIARY PALEONTOLOGY.—A study of the classification and development of the mesozoic and tertiary invertebrate fossil forms, with some consideration of the evolution of vertebrates during the same period. This course is especially helpful to those who specialize in botany or zoology. *Five times a week; second semester.* Dr. BAGG.

19. FIELD GEOLOGY.—Introductory Course.—A field course of two weeks will be taken as a course introductory to the study of Stratigraphy, Paleontology, and Physiography. *Twice a week; first semester.* Assistant Professor SAVAGE.

20. FIELD GEOLOGY.—A short field course in geology will be given during the summer of 1910 (June 16 to 30.) This will involve training in the field, determination of physical features and rock formations, with mapping and description, of a small area in Carroll county, Illinois. *Twice a week; second semester.* Assistant Professor SAVAGE.

CERAMICS

Courses for Graduates

The subject of silicates and the silicate industries offers a unique field for research, since there is probably no other field of technology which needs so much the plow and harrow of the investigator. The problems to be solved are practically unlimited in number, and some branches represent indeed a terra incognita.

CERAMICS 101. The theoretical principles underlying the formation of silicates are considered from the modern standpoint, involving the conceptions of physical chemistry. Lectures and laboratory work. *Five times a week; first semester.*

CERAMICS 102.--Special problems relating to the technology of the clay industries. Some of the topics which may be selected are: Mineralogical constitution of clays, plasticity and the colloidal state, absorption, pyro-chemical and physical changes, exothermic and endothermic processes, the crystalline and amorphous state of burnt clay, thermal expansion of bodies and glazes, bodies and their interaction with glazes, the composition and constitution of glazes, dissolved and underglaze colors, translucency and opacity, the colors of rare oxides in glazes, eutectic studies, reduction and oxidation phenomena, heat radiation and conduction. *Five times a week; both semesters.*

CERAMICS 103.—Special problems relating to the technology of the cement and mortar industries. Topics: Fusion curves of lime, lime-iron, lime-alumina and lime-iron-alumina silicates, the action of catalyzers, crystallization of basic silicates, constitution of cement compounds, hydration and dehydration, thermal studies, etc. *Five times a week; both semesters.*

CERAMICS 104.—Problems relating to the technology of glass. Topics: Fusion curves of glass silicates, limiting compositions, solubility of the oxides in glasses, devitrification, annealing, optical properties, solubility of glasses, viscosity, thermal expansion, pyro-chemical volume change, etc. *Five times a week; both semesters.*

MATHEMATICS

Library Facilities.—The mathematical library of approximately 1900 volumes offers facilities for graduate instruction and research. The major part has recently been moved to a room set aside in the Natural History Building for the departmental library, to which all graduate students have easy access.

In addition to thirty five mathematical journals kept in the department seminar room, the general University library receives regularly about 1,600 periodicals, a considerable number of which are partly devoted to mathematics. We mention in particular the proceedings of various scientific societies such as, for example: Les Comptes Rendus de l'Académie des Sciences (Paris); Sitzungsberichte der k. Akademie (Berlin); Nachrichten der Gesellschaft der Wissenschaften zu Göttingen: Transactions of the Royal Society (London), etc., etc.

Models, Apparatus, Etc.—The department has in its possession a collection of models for instruction and research in analysis, geometry, and kinematics. This collection contains a

large number of plaster of paris casts from the famous collections of Schilling and Wiener, illustrating the properties of surfaces of the first four orders and of the differential properties of surfaces in general. A considerable number of string models are available for demonstrating the properties of ruled surfaces and space curves; other models of wire and celluloid serve to make clear the peculiarities of space curves, in particular those of the third order. Plaster models, some of which have been originated and constructed by students under the guidance of instructors, illustrate important points in the theory of functions. The collection also contains a number of kinematic models illustrating the generation of trochoids of various kinds, inversors, etc.

The department possesses a collection of computing machines, slide rules of various kinds, planimeters, integraphs, a harmonic analyser, etc.

Previous Training.—It is advisable that students entering upon graduate study in mathematics should have had a course in calculus extending through the year and a course in the theory of equations.

Courses for Graduates

101. Functions of Real Variables.—An introduction to the theory of functions of real variables, making use of the general principles of the theory of assemblages. *Three times a week; both semesters.* Professor Townsend.

[Not given 1910–11.]

102. Fourier's Series.—This course is intended for students both of pure mathematics and of the physical sciences. It consists of a brief consideration of the elementary theory of Fourier's and allied series, followed by detailed discussion of numerous physical applications and consideration of classical and recent researches concerning the properties of Fourier's series and operations upon them. *Three times a week; both semesters.* Dr. Crathorne.

[Not given in 1910–11.]

103. Theory of Potential.—The elements of the theory of the logarithmic and Newtonian potential functions. Green's theorems and functions. Boundary value problems. Applications to physical problems. *Three times a week; first semester.* Dr. Crathorne.

[Not given in 1910–11.]

110. Elliptic Functions.—The elements of the theory of elliptic functions with applications to geometry and mechanics. Introduction to the theory of the elliptic modular functions. *Three times a week; both semesters.* Assistant Professor Young.

111. Automorphic Functions.—An introduction to the theory of automorphic functions. The first semester will be devoted mostly to the group-theoretic side of the theory; the second semester will be concerned with the function-theoretic developments and applications. *Three times a week; both semesters.* Assistant Professor Young.

[Not given in 1910–11.]

112. Abelian Functions.—Discussion of the algebraic functions of a complex variable and their integrals, Riemann's surfaces, birational transformations, Abel's theorem with geometrical applications, the inversion problem and the theta functions. *Three times a week; both semesters.* Associate Professor Wilczynski.

[Not given in 1910–11.]

113. Theory of Linear Differential Equations.—*Three times a week; both semesters.* Dr. Crathorne.

120. Elementary Theory of Groups.—The study of the groups which present themselves in arithmetic, geometry, and trigonometry is followed by a determination and study of those which can be represented with a small number of letters. The latter part of the course is devoted to the abstract group theory and the Galois theory of equations. *Three times a week; both semesters.* Professor Miller.

121. Theory of Groups.—Second course. This course presupposes about one year's work in group-theory. It will be devoted to special topics depending upon the needs of the class. The early part of the course will be devoted to the consideration of recent advances and methods along these special lines, and it is hoped that the latter part may be used for research. *Three times a week; both semesters.* Professor Miller.

[Not given in 1910-11.]

124. Theory of Numbers.—The principal subjects considered in this course are: congruences, Kronecker's modular systems, quadratic residues, quadratic forms, and algebraic numbers. *Three times a week; both semesters.* Professor Miller.

[Not given in 1910–11.]

129. Theory of Statistics.—The general methods of statistical investigation, the application of the theory of probabil-

ity to statistical data, the fitting of curves to observation, interpolation, theory of errors, and the mathematical theory of variability and correlation, the application of the principles developed to problems in economics and biology. *Three times a week, both semesters.* Assistant Professor RIETZ.

130. INVARIANTS AND HIGHER PLANE CURVES.—This course includes the general theory of algebraic curves, together with the application of the theory of invariants to higher plane curves. Special study is made of curves of the third and fourth order. *Three times a week; both semesters.*

Assistant Professor SISAM.

[Not given in 1910–11.]

131. ALGEBRAIC SURFACES.—In this course are considered the application of homogeneous coördinates and the theory of invariants to geometry of three dimensions, and also the general theory of surfaces, together with the special properties of surfaces of the third and fourth order. *Thvee times a week; both semesters.* Assistant Professor SISAM.

135. METRIC DIFFERENTIAL GEOMETRY.—Applications of the calculus to the general theory of curves and surfaces based primarily on the use of Cartesian coördinates. Relation of the theory of surfaces to the theory of invariants of a pair of quadratic differential forms. *Three times a week; both semesters.*

Associate Professor WILCZYNSKI.

136. PROJECTIVE DIFFERENTIAL GEOMETRY.—This course includes a brief account of Lie's theory with application to the theory of invariants of systems of linear differential equations. The differential properties of plane and space curves, and of surfaces are considered from a projective point of view. This more general, projective standpoint distinguishes the course from the usual treatment of differential geometry, which is metric. *Three times a week; both semesters.*

Associate Professor WILCZYNSKI.

[Not given in 1910–11.]

140. THE FUNDAMENTAL CONCEPTS OF MATHEMATICS.—A course dealing with general concepts of higher mathematics in their bearing on elementary mathematics. *Three times a week; both semesters.* Assistant Professor YOUNG.

[Not given in 1910–11.]

Courses for Graduates and Advanced Undergraduates

10. INTRODUCTION TO HIGHER ALGEBRA.—This course aims to introduce the student to a few subjects in higher alge-

bra, including linear dependence, theory of matrices, complex numbers and the fundamental theorem of algebra. It begins with a study of a few fundamental properties of polynomials and determinants, presupposing at least two years training in college mathematics including a course in the calculus. *Three times a week; first semester.* Professor MILLER.

11. SYNOPTIC COURSE IN MATHEMATICS.—This course is intended to give a general survey over a considerable portion of modern mathematics. The treatment will be largely historical, and will attempt to demonstrate the importance of mathematics in the intellectual history of the race. The principles which underlie the most important divisions of mathematical science, pure and applied, will be discussed, but no attempt will be made to develop in the student that technical skill and intimate knowledge of detail which is necessary for the specialist. *Twice a week; both semesters.* Assistant Professor WILCZYNSKI.

16. DIFFERENTIAL EQUATIONS.—This course embraces the following topics: General linear equations with constant coefficients, special forms of differential equations of higher order, integration in series, etc. *Three times a week; first semester.* Professor SHATTUCK.

17a. ADVANCED CALCULUS.—This course begins with the consideration of the fundamental notions and theorems of the calculus from a more advanced and critical point of view. This is followed by the study of certain more advanced topics in the integral calculus, including elliptic intregals and functions defined by definite intregals. *Three times a week; second semester.* Dr. CRATHORNE.

19a. SOLID ANALYTIC GEOMETRY.—A general review of the equations of the plane and the right line in space and the more general properties of surfaces of the second degree. The classification and special properties of quadratics, and a brief introduction to the theory of surfaces in general. *Three times a week; second semester.* Dr. BUCK.

20. CALCULUS OF VARIATIONS.—This course has for its aim merely to acquaint the student with those elements of the science which are most needed in the study of the higher subjects of mathematical astronomy and physics. *Three times a week; second semester.* Professor SHATTUCK.

21a. METHOD OF LEAST SQUARES.—The fundamental principles of the subject. The following subjects are studied: Law of probability and error, adjustment of observations, precision

of observations, independent and conditional observations, etc. *Twice a week; first semester.* Assistant Professor STEBBINS.

22a. PARTIAL DIFFERENTIAL EQUATIONS.—This course deals with the integration and determination of the integration constants of such partial differential equations as arise in the study of such subjects as the flow of heat, the vibration of strings, plates, etc., and electricity. *Twice a week; second semester.* Dr. WAHLIN.

23a. AVERAGES AND THE MATHEMATICS OF INVESTMENT.—The meaning, use, and abuse of different kinds of averages. The relation of the theory of probability to averages, and the application of the elements of probability to annuities, insurance, and various branches of science. Such information relating to loans and investments as can best be put into algebraic language, and are of interest to the general student. Many practical problems are given in the evaluation of investment securities. *Three times a week; second semester.* Assistant Professor RIETZ.

24a. FUNCTIONS OF A COMPLEX VARIABLE.—A general introduction to the theory of functions of a complex variable. *Three times a week; both semesters.* Professor TOWNSEND.

27. PROJECTIVE GEOMETRY AND LINEAR TRANSFORMATIONS.—Sets of postulates for general projective geometry and the introduction of analytic methods on the basis of these assumptions. Projective transformations in the line, plane, and space. Introduction to the algebra of matrices and the theory of invariants. Subgroups of the general projective group. Euclidean, non-euclidean, and affine geometries. Theory of conics and quadric surfaces. Real and complex geometries. Throughout the emphasis is on geometric and algebraic interrelations. *Three times a week; both semesters.* Dr. BÖRGER.

30. SEMINARY AND THESIS.—*Three times a week; both semesters.* Professors TOWNSEND, MILLER, Associate Professor WILCZYNSKI, Assistant Professors RIETZ, YOUNG, SISAM.

31. ACTUARIAL THEORY.—The application of probability to life contingencies, the construction and graduation of mortality tables, the elements of fire insurance and the calculation of premiums for various types of insurance. *Three times a week; first semester.* Assistant Professor RIETZ.

PHYSICS

The prerequisite for graduate work in physics is a college course in general physics with a year's laboratory course in introductory physical measurements. The student who is to do major work in physics should also have had additional courses in physics or teaching experience, unless the training in his minor subjects, mathematics or chemistry, has been strong and complete. He should also have a knowledge of French and German sufficient to use references in these languages. The courses named below are those open for candidates for the Master's and Doctor's degrees. A large part of the last year's work of the candidate for the Doctor's degree is investigational, along either the experimental or the theoretical side of physics. In addition to these major graduate courses, the courses in elementary dynamics, heat, light, electrical measurements, and introductory electrical theory, (courses 114, 125, 120, 104, 130), are arranged with certain additions for graduate credit. The "intermediate" courses on heat, light and electricity and magnetism, (courses 15, 16, 17), may be offered by students making a minor in physics.

Courses for Graduates

121. Recent Advances in Physical Science.—Lectures illustrated by experiments on the more recent developments of physics. Assistant Professor Knipp.

[Not given in 1910–11.]

123. Sound.—Lectures and recitations, *Barton's Text-book on Sound* is used. *Twice a week; both semesters.*

Assistant Professor Watson.

124. Conduction of Electricity through Gases and Radio-activity.—An experimental course, with systematic reading and discussions. *McClung's Conduction of Electricity through Gases and Radio-activity* is used as a text-book with systematic references to the classic text-books of J. J. Thomson and Rutherford, and also to the papers in the journals. *Three times a week; both semesters.* Professor Carman.

126. Journal Club.—Weekly meeting of the instructors and advanced students of the department to discuss assigned papers and topics. These discussions are often accompanied by experimental demonstrations. *Once a week; both semesters.*

127. Electron Theory.—Lectures and discussions on cathode rays, the general properties of the electron, theory of Roentgen rays, optical properties of moving media, principle of

relativity, and the new corpuscular theory of light. In 1910–11 this course will consist of a consideration of the electron theory of magnetism, of the Zeeman phenomenon, of magneto-optics and electro-optics and the theory of conduction of electricity through gases will be dealt with. The aim of these lectures is to introduce the student of physics into the modern problems along these lines. *Twice a week; both semesters.*

Assistant Professor KUNZ.

131. INVESTIGATION OF SPECIAL PROBLEMS.—An advanced course in laboratory or in design and calculation. A problem is chosen and worked out with the advice and direction of the instructor. *Three or five times a week; both semesters.*

Professor CARMAN, Assistant Professors KNIPP, WATSON, SCHULZ, KUNZ.

132. MATHEMATICAL PHYSICS.—Lectures and recitations on special topics in theoretical physics. The following is an outline of the courses offered under this head.

DYNAMICS.—In the first part of this course dynamics of a material system is dealt with from a more elementary point of view. The ordinary methods of the calculus are applied to the determination of the center of gravity, of moment of inertia and of potentials. In the second part the principle of least action and Lagrange's equations are developed and applied to various problems. The motions of the top and its applications are included. *Three times a week; both semesters.*

Assistant Professor KUNZ.

[Not given in 1910–11].

ELECTRODYNAMICS.—Lectures and collateral reading on the principles of electrodynamics. Maxwell's theory and modern modifications are studied. Jean's Mathematical Theory of Electricity and Magnetism is used as a text-book. The course involves application of spherical harmonics, conjugate funtions, potential theory, and some theorems of vector analysis. The course includes the theory of electromagnetic waves. *Four times a week; both semesters.*

Assistant Professor KUNZ.

THERMODYNAMICS.—The fundamental principles are studied and applications made to physical and chemical phenomena. Lectures and recitations. The theory of the conduction and radiation of heat is included. *Three times a week; both semesters.*

Assistant Professor KUNZ.

133. SEMINARY.—*Three or five times a week; both semesters.*

Professor CARMAN, Assistant Professors KNIPP, WATSON, SCHULZ, KUNZ.

Courses for Graduates and Advanced Undergraduates

4. ELECTRICAL AND MAGNETIC MEASUREMENTS.—Laboratory exercises with discussions and recitations. The course extends throughout the year. It is taken by junior students in electrical engineering and is recommended to others wishing an exact course in electrical and magnetic measurements. *Twice a week; both semesters.*

Assistant Professor KNIPP, Mr. STIFLER, Dr. STEPHENSON.

14. ELEMENTARY DYNAMICS AND PHYSICAL APPLICATIONS.—This course discusses with elementary calculus methods, the fundamental theorems in mechanics, heat, light and electricity. It forms an introduction to theoretical physics and follows a course in general physics. Lectures and recitations. *Three times a week; both semesters.* Dr. TAYLOR.

20a. LIGHT.—Lecture and recitations with class demonstrations of special phenomena. Modern theories are discussed and readings assigned in the texts of *Drude*, *Wood*, and *Preston*. *Twice a week; first or second semester.*

Assistant Professor SCHULZ.

20b. LIGHT.—A laboratory course in light measurements, selected experiments in dispersion, refraction, interference, polarization, etc. *Two to five times a week; both semesters.*

Assistant Professor SCHULZ.

25. HEAT.—An advanced experimental and recitation course. Special attention is given to extreme temperature measurements, and the properties of bodies over a wide range of temperatures. *Le Chatalier's High Temperature Measurements* is freely used. *Twice a week; second semester.*

Assistant Professor WATSON.

30a. INTRODUCTION TO THEORETICAL ELECTRICITY.—A course of lectures and recitations discussing the phenomena with elementary calculus methods, and with occasional lecture-room demonstrations. Text-book: *Foster and Porter's Electricity and Magnetism*, or *Thomson's Elements of Electricity and Magnetism*. *Twice a week; both semesters.* Assistant Professor KNIPP.

30b. ELECTRICITY AND MAGNETISM.—A course of electrical measurements, including experimental work in some of the more recent developments, such as electric waves and their application to wireless telegraphy, electrical discharge in gases, etc. *Two, three or four times a week; both semesters.*

Assistant Professor KNIPP.

E. The Biological Sciences.

BOTANY

The work outlined under "Courses for Graduates" is open only to those who have had liberal botanical training including at least one year of successful study in the general line in which it is desired further to specialize. These courses may be elected for minor or for major work.

Courses for Graduates

101. CYTOLOGY.—The influence of external agents on the cell. Special subjects for investigation are assigned upon consultations. Reports and discussions of current literature and research results. *Five times a week; both semesters.*
Assistant Professor HOTTES.

102. PHYSIOLOGY.—The effects of external stimuli on growth and movement. Special subjects for investigation are assigned upon consultation. Reports and discussions of current literature and research results. *Five times a week; both semesters.*
Assistant Professor HOTTES.

103. BACTERIOLOGY.—Investigations upon morphologic and physiologic variation due to treatment; systematic studies upon the number, validity, and relationship of species, research upon special saprophytic or parasitic kinds of bacteria and upon methods of favoring or combating their activities. *Five times a week; both semesters.* Professor BURRILL.

104. BACTERIOLOGY.—Special methods, intended to develop technical skill introductory to research upon pathogenic bacteria. *Three times a week; second semester.* Dr. MACNEAL.

105. BACTERIOLOGY.—Investigations upon micro-organisms related to the animal body in health and disease. *Five times a week; both semesters.* Dr. MACNEAL.

106. VEGETABLE PATHOLOGY.—Diseases of plants and disease agents. Special subjects are assigned upon consultation. *Five times a week; both semesters.* Professor BURRILL.

107. ECOLOGY AND PHYTOGEOGRAPHY.—Investigations upon plant associations and phytogeographic relations of selected areas, based on approved field work. Reports and discussions. *Two to five times a week; both semesters.* Dr. GLEASON.

Courses for Graduates and Advanced Undergraduates

After at least one year of approved botanical work and fur-

ther prerequisites, on consultation, graduates may elect any of the courses 3, 5, 7, 8, 9, 10, 16, 18, and 19, or 20 for minor credit; and any of the courses 3, 7, 8, 9, or 18 and 19, with assigned additions for major credit.

3. CYTOLOGY AND PHYSIOLOGY.—The first semester is devoted mainly to cytology and histology, with special attention to technique; the second, to a study of the influences of external stimuli on growth and movement. *Five times a week; both semesters.* Assistant Professor HOTTES.

5. BACTERIOLOGY.—General principles of the science, methods of procedure, and a study of selected forms. Lectures, recitations, and laboratory work. *Five times a week; both semesters.* Professor BURRILL, Assistant Professor MACNEAL.

7. PLANT PATHOLOGY.—A study of the principal groups of parasitic fungi and plant diseases due to them, with methods of investigation and control. *Five time a week; both semesters.* Professor BURRILL.

8. BACTERIOLOGY.—A detailed study of selected species of bacteria or investigations upon assigned subjects. *Two to five times a week; both semesters.* Professor BURRILL.

9. CYTOLOGY AND PHYSIOLOGY, ADVANCED COURSE.—Special laboratory problems in certain phases of cytology and physiology. *Twice a week; both semesters.* Assistant Professor HOTTES.

10. SEMINARY.—Reports and discussion upon assigned topics and results of research work. *Once a week; both semesters.* Professor BURRILL.

16. TAXONOMY OF SPECIAL GROUPS.—Mostly laboratory and herbarium work, and assigned reading. *Five times a week; both semesters.* Dr. GLEASON.

18. ECOLOGY.—Field and laboratory studies of selected areas, with assigned reading and lectures. The field work must be done wholly or in part during the preceding summer on an area approved by the instructor. *Two to five times a week; both semesters.* Dr. GLEASON.

19. SEMINARY IN ECOLOGY.—Reports and critical discussions of current literature and research work. For graduate credit must be taken with or after course 18. *Once a week; both semesters.* Dr. GLEASON.

20. ECOLOGY AND TAXONOMY.—Special problems upon individual assignments, dealing mainly with the plants of Illinois and vicinity. *Two to five times a week; both semesters.* Dr. GLEASON.

ENTOMOLOGY

The prerequisite for graduate work in entomology is one year's work in biological courses, including an equivalent either of Zoology 10 or Entomology 1 or 4. Entrance upon major work in entomology requires the equivalent of Entomology 2 and 3.

Courses for Graduates

103. FAUNISTIC ENTOMOLOGY.—Problems in taxonomy, distribution, and ecology, accompanied by field work, conferences, and lectures. The department is especially favored in the work of this course by the fact that the collections and library of the State Entomologist and of the State Laboratory of Natural History are available for its use. *Five times a week; both semesters.*
Professor FORBES, Assistant Professor FOLSOM.

108. INDIVIDUAL RESEARCH COURSES. — Morphological, systematic, ecological, and economic entomology. *Arrange time; both semesters.* Professor FORBES, Assistant Professor FOLSOM.

Courses for Graduates and Advanced Undergraduates

2. GENERAL ENTOMOLOGY.—This course and entomology 3 form a year's connected major work in entomology, covering substantially the whole field. The present course is devoted mainly to field entomology in the fall and later to the morphological and physiological aspects of the subject. Beginning with the collection and preservation of specimens and the making of field observations, it is continued by laboratory studies of typical insects, made with special reference to the recognition of adaptive structures, and experimental work intended to determine their exact utilities. *Five times a week; first semester.*
Assistant Professor FOLSOM.

3. GENERAL ENTOMOLOGY.—To be taken either with or without the preceding course. The classification and determination of insects, the study of life histories in the insectary and by field observation, and the collection of information with respect to the ecological relations of insects, are the principal objects of this course. *Five times a week; second semester.*
Assistant Professor FOLSOM.

5. ADVANCED ENTOMOLOGY.—Under this head students desiring advanced work in entomology, especially as a preparation for thesis work in this subject, will be individually provided for on consultation with the entomological instructors. The course may be made to cover one or two semesters and to earn a

three-hour or a five-hour credit in each. At least a three-hour course for one semester will be required as a preparation for entomological thesis work. *Three to five times a week; both semesters.*

Professor FORBES, Assistant Professor FOLSOM.

7. SYSTEMATIC ENTOMOLOGY.—This course, while primarily entomological, is designed to be of general use to students of biology. The lectures include a historical and critical survey of the systems of classification; a discussion of the aims and methods of classification; the nature of species, and genera, and other groups, and the rules of nomenclature; the preparation of taxonomic articles, involving the study of bibliography, synonymy, analytical keys, etc. These subjects receive practical treatment in laboratory, and to qualified students the unworked material of the State Laboratory of Natural History is available for study. *Three times a week; both semesters.*

Assistant Professor FOLSOM.

8. ADVANCED ECONOMIC ENTOMOLOGY.—A course of lectures, recitations, and field and laboratory work intended to prepare students for service as economic entomologists in state and government positions. Agronomy 7 and Horticulture 1, 2, and 3 should also be taken as a part of this preparation. *Three times a week; both semesters.*

Professor FORBES, Assistant Professor FOLSOM.

HOUSEHOLD SCIENCE

Courses for Graduates

101. HOME ECONOMICS.—A study of the origin and development of home economics, with particular reference to its industrial, educational, and sociological aspects. *First or second semester.*

Professor BEVIER.

102. SPECIAL INVESTIGATIONS.—Problems in the application of the principles of bacteriology, chemistry, and physiology, to the ordinary processes used in preparation of food. *First or second semester.*

Professor BEVIER.

Courses for Graduates and Advanced Undergraduates

4. FOOD AND NUTRITION.—An application of the principles of pure science to the problems of food and nutrition. The problems may be physiological, chemical or bacteriological. *Five times a week; first semester.*

Professor BEVIER, Assistant Professor USHER.

5. DIETETICS.—The work in dietetics includes the follow-

ing topics: The principles of diet, the relation of food to health; influence of age, sex, and occupation on diet; the construction of dietaries; dietetic treatment of certain diseases; principles of home nursing. *Three times a week; second semester.*

Assistant Professor USHER.

PHYSIOLOGY.

Courses for Graduates

103. RESEARCH.—Every facility and encouragement, so far as the resources of the laboratory and library permit, are offered to those prepared to avail themselves of these, for research as part of the work for the Master's or the Doctor's degree, or for carrying on original work for publication. The research equipment of the laboratory is adequate for work in the subjects of histology, physiology, and pathology.

Assistant Professor MCCLELLAN.

111. PHYSIOLOGICAL JOURNAL CLUB.—The club is composed of the teaching staff of the department, the graduate students, and such undergraduates as are sufficiently advanced to participate. Recent articles of interest in current journals will be reported and discussed. This will give the student practice and confidence in presenting a condensed synopsis of a subject before a meeting. Each student will have to report a paper about once in two months. Time will be arranged, as far as possible, to suit the convenience of members of the club.

Courses for Graduates and Advanced Undergraduates

HISTOLOGY.—This course consists of a study of the fundamental mammalian tissues, and the microscopic anatomy of the organs. Lectures and laboratory. *Five times a week; first semester.* Assistant Professor MCCLELLAN.

2. MAJOR COURSE.—This will include a study of the physiology of nerve and muscle, circulation, respiration, secretion, digestion, metabolism, etc. Lectures and laboratory work. *Five times a week; second semester.*

Assistant Professor MCCLELLAN, Mr. CORPER.

5. SPECIAL PHYSIOLOGY.—This course is given to meet an emergency, which sometimes arises, where a student wishes to take up a special line of work not specified in one of the other courses, and not involving the preparation of a thesis. At the discretion of the head of the department students may register for such work. Arrange details with the instructor.

Assistant Professor MCCLELLAN, Dr. STANLEY.

ZOOLOGY.

The equipment of the department includes the usual apparatus, microscopes, microtomes, paraffin baths, demonstration material and reagents. The various special laboratories are being equipped with special apparatus and demonstration material in accordance with their particular needs. Provision is made for meeting such special demands as may arise in connection with individual work.

The University Museum contains valuable series of mounted vertebrates, of Ziegler embryological models, and of alcoholic material in all groups; these are available as needed for either teaching or research.

The extensive collections and library of the Illinois State Laboratory of Natural History are freely available to advanced students. They are unusually rich in that which pertains to fresh water biology. The private library and collections of the head of the department, which contain much material on invertebrate morphology and on parasitism, are also placed at the disposal of graduate students.

Two years of undergraduate work in zoology are ordinarily presupposed as a condition for entering upon graduate study in the department. When the work is chosen for a minor the courses listed for graduates and undergraduates to be acceptable must be preceded by at least one full year's undergraduate work in zoology. Work done at other institutions will be evaluated on conference with the head of the department.

Courses for Graduates

103. General Embryology.—History of the germ cells, maturation and fertilization, theories of development and inheritance, and recent experimental researches in the mechanics of development and the correlative differentiation of organs. Conferences and laboratory work. *Arrange time; both semesters.*

107. Parasitology.—The structure and life history of animal parasites, together with their relations to disease. Conferences and assigned readings with individual laboratory problems. *Two to five times a week; both semesters.* Professor Ward.

113. Experimental Zoology.—Assigned problems in experimental embryology, regeneration, variation, and heredity. The problems are individual and their scope is more or less extended to suit individual needs. *Arrange time; both semesters.*

Assistant Professor Zeleny.

117. Faunistic Zoology.—Problems in taxonomy, distribution, and ecology, accompanied by field work, conference, and lectures. The work of this course is favored by a natural history survey of the state now in progress at the University; students have the advantage of the collections, library, apparatus, and operations of this survey as an aid to their personal studies. *Three to five times a week; both semesters.*

Associate Professor Smith, Dr. Adams.

121. Individual Research Courses.—

(a) Zoological problems. Professor Ward.

(b) Systematic and faunistic zoology.

Associate Professor Smith.

(c) Zoogeography and Animal Ecology. Dr. Adams.

(d) Vertebrate Embryology.

(e) Structure and Development of the Nervous System.—Animal behavior.

(f) Experimental Zoology. Assistant Professor Zeleny.

Courses for Graduates and Advanced Undergraduates.

3. Microscopical Technique and General Vertebrate Embryology.—Theory and practice of microscopical technique, followed by the study of vertebrate embryos in early stages of development. In the laboratory the student will first be trained in the ordinary methods of fixation, embedding, section cutting, staining, and mounting. Embryological material will be prepared, and used later in connection with the study of introductory embryology, which completes the course. *Three times a week; first semester.*

5. Animal Behavior.—Lectures and demonstrations on the reactions of the lower animals to external stimuli. The results of experimental work on the influence of light, heat, gravity, chemical substances, etc., are considered with reference to the habits of animals in their normal environment. The course will include such studies of sense organs and adaptive structures as may be necessary. *Twice a week; second semester.*

[Not given in 1910-11.]

6. Vertebrate Organogeny.—A continuation of course 3 intended for medical students and others who desire an acquaintance with the development of the organs of the vertebrate body. The course includes lectures, assigned readings in a text-book of human embryology, and laboratory studies on embryos of the chick and pig. *Three times a week; second semester.*

7. The Structure and Functions of the Vertebrate Nervous System.—Lectures and laboratory work on the structure of the vertebrate nervous system, including a study of the grouping and chaining of the neurones to form the central and peripheral nervous organs; of the nervous impulse; of the stimulation of the sense organs; and of various reflex actions. The work will include dissections, practice in the preparation of nervous tissues for the microscope, and experimental physiological work. *Three times a week; first semester.*

[Not given in 1910-11]

9. Animal Ecology.—Introductory study on the relation of animals to their natural environment. Special stress is laid upon the processes of change in environment and their influence upon animal life. Field trips are made for a study of the local fauna and the conditions under which it lives, and for instruction in methods of observation and the making of notes and collections. In the laboratory the specimens collected are observed and determined, reports are prepared, and a working knowledge of the literature is acquired. Principal attention is given to insects, mollusks, reptiles, amphibians, and fishes. *Five times a week; second semester.* Dr. Adams.

11. Principles of Zoogeography.—An introduction to the study of the geography distribution of animals, in which particular attention is given to the faunas of North America and of Illinois. The fauna is considered in its relation to the complete environment—climate, physiography, geology, vegetation, etc.—and from the stand-point of its origin and its dynamic relations; laboratory work on maps, and fields excursions. *Two or three times a week; Saturday excursions to be arranged; first semester.* Dr. Adams.

13. Experimental Embryology and Regeneration.—An analysis of the factors concerned in individual development. Open only to juniors and seniors, except on special permission. Lectures and demonstrations. *Twice a week; first semester.*

Assistant Professor Zeleny.

13a. Experimental Embryology and Regeneration. (Laboratory.)—The application of the experimental method to a definite problem in embryology or regeneration. The work will be individual. *One to five times a week; both semesters.*

Assistant Professor Zeleny.

15. Variation and Heredity.—An analysis of the facts of variation and heredity with reference (a) to the factors of or-

ganic evolution and (b) to the principles of animal breeding. Lectures and demonstrations. *Twice a week; second semester.*

Assistant Professor ZELENY.

15a. VARIATION AND HEREDITY. (Laboratory).—The application of the experimental method to a definite problem in variation or heredity. The work will be individual. *One to five times a week; both semesters.* Assistant Professor ZELENY.

17a. FIELD ZOOLOGY.—The work is planned to give as comprehensive a knowledge as practicable of the animal life of a restricted locality. Collection, preservation and identification of various kinds of animals, together with observations of the habits and life histories of selected forms, constitute the major part of the work. *Three times a week; first semester.*

Associate Professor SMITH.

17c. ADVANCED FIELD ZOOLOGY—A continuation of 17a and 17b, providing an opportunity for intensive work on more restricted problems in connection with the local fauna. A taxonomic or distributional problem is studied and the work may be made introductory to subsequent investigation in this field. *Three to five times a week; both semesters.*

Associate Professor SMITH.

20. CURENT LITERATURE.—The instructors and advanced students of the department will meet at stated intervals as a journal club for the presentation and discussion of the results of recent zoological investigation. This course is open to all qualified students of zoology and should be taken by those intending to graduate with a thesis. *Once a week; both semesters.*

Assistant Professor ZELENY.

21. INTRODUCTION TO ZOOLOGICAL RESEARCH.—Students looking forward to graduate work and to independent investigation will be assigned definite topics, usually repeating the work of earlier investigators and will be directed in working out the morphology, life history, or reciprocal relations of invertebrate forms. Laboratory work with stated conferences and assigned reading. *Two to five times a week; both semesters.*

Professor WARD.

29. ADVANCED ANIMAL ECOLOGY.—A study of special problems in ecology, distribution and faunas, with reference to the interpretations of the relation between animals and their environments. Conferences, laboratory and field work. *Two to five times a week; both semesters.* Dr. ADAMS.

F—Engineering

ARCHITECTURE.

Entrance upon graduate work in architecture presupposes the full undergraduate course in that subject. Semi-weekly conferences are held and additional instruction given, in all courses, as may be required.

Courses for Graduates

101. ARCHITECTURAL CONSTRUCTION.—This may include a study of large buildings constructed of wood, or masonry, steel frame and tiles, or re-inforced concrete, or a combination of these topics. *Arrange time; both semesters.*

Professor RICKER, Associate CLARK, Mr. WEAVER.

102. SANITATION OF BUILDINGS.—This may comprise the planning of large buildings with reference to their sanitation, warming and ventilation, electric lighting and power, or a combination of these subjects. *Arrange time; both semesters.*

Professors RICKER, WHITE, Associate CLARK.

103. ARCHITECTURAL DRAWING.—This may include higher graphic statics, stereotomy, higher perspective, advanced water color painting, or any combination of these topics. *Arrange time; both semesters.* Professors RICKER, WELLS, Associate CLARK, Mr. WEAVER.

104. ARCHITECTURAL DESIGN.—This may comprise the study and practice of advanced architectural design, of the esthetics of architecture, of industrial design, or a combination of these subjects. *Arrange time; both semesters.*

Professor WELLS, Assistant Professor CASE.

105. ARCHITECTURAL PRACTICE.—This may include the translation of an approved architectural book, indexing and classification of data, specifications and estimates of cost for large buildings, office methods and systems, or a combination of these topics. *Arrange time; both semesters.*

Professors RICKER, WHITE.

CIVIL ENGINEERING

Entrance upon graduate work in civil engineering presupposes the full undergraduate course in that subject.

Courses for Graduates.

107. BRIDGE DESIGN.—The determination of the stresses

n swing, cantilever, and suspension bridges; and a study of structural details, of shop equipment, and of methods of fabrication. This work may require an inspection of, and report upon, bridge shops or of work in progress. *Three to six times a week; first or second semester.* Assistant Professor DUFOUR.

110. METALLIC BUILDING CONSTRUCTION.—The design of the metal skeleton of buildings for various purposes. The work is taught by means of lectures, problems, and inspection of construction work in progress. *Three to five times a week; first or second semester.* Assistant Professor MALCOLM.

115. REINFORCED CONCRETE DESIGN.—A study of the materials, the design, the forms, and the erection of reinforced concrete structures. *Arrange time; first or second semester.* Associate Professor BROOKS.

ELECTRICAL ENGINEERING

Entrance upon graduate work in electrical engineering presupposes the full undergraduate course in that subject.

Courses for Graduates

101. ADVANCED COURSE IN ALTERNATING CURRENTS.—A study of polyphase circuits, alternating current machinery, alternating current measuring apparatus, or a combination of these subjects. *Twice a week; both semesters.* Professors BERG, BROOKS.

102. THE GENERATION, TRANSMISSION, AND UTILIZATION OF ELECTRICAL ENERGY.—A study of dynamo-electric machinery, light and power plants, switchboards, and transmission lines. *Twice a week; both semesters.* Professor BERG, Assistant Professor PAINE.

103. ELECTRICAL DESIGN.—The development of plans for an electrical machine or apparatus of specified character, or for the arrangement of an electrical plant, or for the installation of such machinery or apparatus. *Twice a week; second semester.* Professor BERG, Assistant Professor WALDO.

104. TELEGRAPHY AND TELEPHONY.—*Twice a week; second semester.* Professor BROOKS, Assistant Professor PAINE.

105. ELECTRICAL ENGINEERING RESEARCH.—An experimental investigation of some electrical phenomena, or tests of some electrical machine, or of a plant of such machines. *Twice a week; both semesters.* Professor BERG, Assistant Professor BRYANT.

MECHANICAL ENGINEERING

Entrance upon graduate work in mechanical engineering presupposes the full undergraduate course in that subject.

Courses for Graduates

106. HEAT MOTORS.—Special emphasis is laid on the advanced theory of the internal combustion motor, and of the steam turbine. The general principles and methods of refrigeration are studied. *Twice a week; second semester.*
Associate Professor GOODENOUGH.

107. THERMODYNAMICS.—An advanced study of the general principles of thermodynamics and of their application to the solution of various physical and chemical problems. *Three times a week; first semester.* Associate Professor GOODENOUGH.

109. MACHINE DESIGN.—A study of the general principles of rational design, with emphasis on the application of mechanics of materials. Individual problems are assigned. *Twice a week; first or second semester.* Assistant Professor LEUTWILER.

112. LABORATORY INVESTIGATIONS.—This course consists of special investigations of problems relating to combustion of fuel, boiler economy, steam engines and turbines, gas engines and producers, properties of explosive mixtures, mechanical refrigeration, etc. Emphasis is laid upon original work. *Three times a week; first or second semester.* Assistant Professor ——

114. ENGINEERING DESIGN.—The student is required to make a design with estimates and specifications of a complete engineering project, such as a manufacturing plant, a power plant, or a pumping station. *Twice a week; first or second semester.*
Assistant Professor LEUTWILER.

MECHANICS, THEORETICAL AND APPLIED

Entrance upon graduate work in theoretical and applied mechanics presupposes a full undergraduate course in that subject.

Courses for Graduates

101. ANALYTICAL MECHANICS.—This is an extension of the undergraduate course. The foundation of mechanics and its various relations, the methods of treatment and attack, and the study of the more complex problems and applications are taken up. A critical and comparative study of texts is also made. *Twice a week; first semester.* Assistant Professor ENGSTROM.

102. Resistance of Materials.—Advanced work on the properties of materials used in engineering construction and the methods of determining these properties; analysis and investigation in mechanics of materials, including the effect of form of member in a structure or machine and the method of application of forces. Comparative study of texts may be made. *Twice a week; second semester.* Assistant Professor Moore.

103. Hydraulics and Hydraulic Engineering.—The laws of hydraulics and their application to engineering problems; hydraulic power and its development; design and investigation. *Twice a week; second semester.*

Professor Talbot, Assistant Professor Moore.

104. Experimental Work in Laboratory of Applied Mechanics—(a) Laboratory investigation in the materials testing laboratory on materials and on their action as used in machines and structures; (b) experimental work in hydraulic laboratory with pumps, motors, and measuring devices, and the investigation of the laws of hydraulics, the development of power, and the study of various hydraulic problems. *Twice a week; both semesters.*

Professor Talbot, Assistant Professor Moore.

105. Experimental and Analytical Work in Reinforced Concrete.—Research work in reinforced concrete. The interpretation of available experimental results and their application to the design of structures. The principles of construction and a study of typical reinforced concrete structures. *Twice a week; both semesters.* Professor Talbot.

MUNICIPAL AND SANITARY ENGINEERING

Entrance upon graduate work in municipal and sanitary engineering presupposes a full undergraduate course in that subject.

Courses for Graduates

102. Water Supply Engineering.—Advanced work in water supply engineering will be arranged to fit the conditions of individual classes. Sources and requirements of water supply, general water works construction, pumps and pumping, design of reservoirs and elevated tanks, and water works operation and the valuation of plants are among the topics which may be treated. *One to three times a week; first or second semester.*

Professor Talbot.

103. Sewerage.—General sewerage design and construction, a study of sewerage systems, hydraulics of sewers, and a

study of run-off, are examples of the work which may be taken up. *Once or twice a week; second semester.* Professor TALBOT.

106. WATER PURIFICATION, SEWAGE DISPOSAL AND GENERAL SANITATION.—The design, construction, and operation of water purification plants and of sewage disposal works, the study of existing plants, comparison of results and cost of construction and operation may be taken up in this course. Experimental work on water filters, septic tanks, etc., may be included. Garbage disposal and general sanitation may also be taken. *Once a week; second semester.* Professor TALBOT.

RAILWAY ENGINEERING

Entrance upon graduate work in the department of railway engineering presupposes a full undergraduate course in that subject.

The equipment of the department of railway engineering includes a dynamometer car designed for train resistance and locomotive tests on steam roads, and an electric test-car for similar work on electric lines. The department owns also a drop testing machine and a brakeshoe testing machine, both of which conform, in their design, to the standards of the Master Car Builders' Association.

Courses for Graduates

102. LOCOMOTIVE DESIGN.—Study and analysis of modern practice concerning steam pressure, compounding, superheating, etc. The work in this course may be arranged to suit special requirements of the individual student. *Once a week; both semesters.* Professor GOSS.

106. LOCOMOTIVE OPERATION.—Study and determination of train resistance and locomotive tractive effort. The application of these and other matters in the establishment of tonnage ratings. *Once a week; both semesters.*

Associate Professor SCHMIDT.

108. ELECTRIC RAILWAY PRACTICE.—This course deals with the design, selection, operation, and maintenance of electric railway equipment. Central station, sub-station, rolling stock, and line equipment are considered. The emphasis is put upon either design or operation according to the training and purpose of the student. *Once a week; both semesters.* Mr. KENDALL.

110. RAILWAY LOCATION.—This course is essentially a study of the effects of the location of a railway upon its earning capa-

city. It deals with the engineering and economic problems met with in original location, as well as in the relocation and reduction of grades of existing lines. *Once a week; both semesters.*
Assistant Professor ROBERTS.

G—Agriculture

AGRONOMY

Students taking up graduate work in agronomy must have had the full undergraduate course in the subject.

Courses for Graduates

101. SOIL INVESTIGATION.—A study of systems of soil investigation; sources of error and methods of control; interpretation or results. *Once a week; second semester.*
Professor HOPKINS.

103. SOIL HISTORY.—Different systems of agricultural practice and their ultimate effect upon the soil. *Once a week; second semester.* Professor HOPKINS.

109. EXPERIMENTATION IN THE PRODUCTION OF FIELD CROPS.—The work may include actual practice in planning and conducting field experiments.
[Not given in 1910-11]

112. PLANT BREEDING.—This course includes a detailed study of experiments at this station, and of methods and results reported from other states and from foreign countries. *Twice a week; both semesters.* Assistant Professor SMITH.

Courses for Graduates and Advanced Undergraduates.

9. SOIL PHYSICS AND MANAGEMENT.—*Five times a week; first semester.* Assistant Professor MOSIER, Mr. GUSTAFSON.

11. SOIL BIOLOGY.—Soil fertility as influenced by biological agencies. *Twice a week; second semester.*
Assistant Professor PETTIT.

12. SOIL FERTILITY, FERTILIZERS, ROTATIONS.—The influence of fertility, natural or supplied, upon the yield of various crops; effect of different crops upon the soil and upon succeeding crops, etc. *Five times a week; second semester.*
Professor HOPKINS, Mr. ECKHARDT, Mr. FISHER.

15. COMPARATIVE AGRICULTURE.—Lectures. *Once a week.*
Professor DAVENPORT.

16. GERMAN AGRICULTURAL READINGS.—The current numbers of German journals on agricultural science are required as a text. *Twice a week; second semester.* Professor HOPKINS.

22. Plant Breeding.—The improvement by breeding of field crops, including the grains, grasses, and legumes; the principles and methods of selection with critical studies of results obtained by various investigators. Lectures, assigned readings, demonstrations, and laboratory exercises. *Second semester.*

Assistant Professor Smith.

23. Plant Food Supplies.—The world's supply of plant food materials, including methods of utilization. *Once a week; second semester.* Assistant Professor Pettit.

24. Mechanical Composition of Soils.—A study of the mechanical composition of soils and its influence upon granulation, absorption and retention of moisture, and other physical properties affecting crop production. *Arrange time; first semester.* Assistant Professor Mosier.

ANIMAL HUSBANDRY

Students entering graduate work in animal husbandry should have had a thorough course in the fundamental principles of the subject, substantially equivalent to the prescribed undergraduate work in animal husbandry in this University

Courses for Graduates.

103. Live Stock Experimentation.—Objects, methods and the sources of error in experimental work dealing with the feeding, breeding and management of farm animals. Critical study of live stock experiments at this and other experiment stations. *Once a week; both semesters.* Professor Mumford.

110. Animal Nutrition.—This course includes a thorough study of the chemical and physiological changes, reactions, and processes involved in the activities of animal life, namely mastication, digestion, absorption, assimilation, disassimilation, respiration, circulation, secretion and reproduction. *Three times a week; both semesters.* Professor Grindley.

111. Animal Nutrition.—An advanced course for the detailed study of methods employed in the examination and analysis of feeding stuffs and animal substances, including flesh, fat, bone, urine, feces, and manufactured animal products. This is a combined classroom and laboratory course. *Arrange time; both semesters.* Professor Grindley.

112. Bacteriology.—Investigation upon microorganisms related to the animal body in health and disease.

(a) Bacteriology of the digestive tract;

(b) Bovine tuberculosis;

(c) Infectious abortion of cattle. *Arrange time; both semesters.* Dr. MACNEAL.

116. SEMINARY.—Reports and discussions of investigations in the field of Animal Husbandry, such as feeding, breeding and economic aspects of live stock production, and the chemical, physiological and bacteriological problems of animal nutrition. *Arrange time; both semesters.* Professor MUMFORD and others.

Courses for Graduates and Advanced Undergraduates

7. PRINCIPLES OF ANIMAL NUTRITION. *Five times a week; first half of first semester.* Assistant Professor DIETRICH.

22. ADVANCED STOCK JUDGING.—A study of animal conformation with reference to market and show yard form, quality and condition. *Five times a week; second semester.* Various members of the department.

24. MEAT.—A study of the influence of type, condition, age, sex and feeds upon the yield and market grade of meat products. *Once a week; second semester* Assistant Professor HALL.

25. WOOL.—The influence of the factors affecting the quality, quantity, strength and condition of wool. *Once a week; second semester.* Mr. COFFEY.

26. SWINE.—The factors of animal nutrition that have to do with the large and economical production of pork and the determination of type in swine. *Once a week; second semester.* Assistant Professor DIETRICH.

DAIRY HUSBANDRY

Courses for Graduates

101. ECONOMIC MILK PRODUCTION.—A special study of differences in the efficiency of dairy cows, cause and effect of the same, and the relation this bears to successful dairy farming. *Twice a week; both semesters.* Professor FRASER.

102. RESEARCH.—A careful study of the investigations in progress in the dairy herds of the state. *Twice a week; both semesters.* Professor FRASER.

103. RESEARCH.—Dairy feeding problems. *Twice a week; both semesters.* Professor FRASER.

Courses for Graduates and Advanced Undergraduates

7. FACTORY MANAGEMENT.—Lectures, assigned readings,

and laboratory work. *Three times a week; second half of second semester.* Mr. HEPBURN, Mr. LANG.

8. CITY MILK SUPPLY.—Proper methods of handling and preparing milk and cream for direct consumption; preventing contamination, pasteurizing, standardizing, modifying, bottling, transporting, and delivering. Certified milk; value of milk as a food. Milk commissions; legal requirements of cities and states. *Second half of second semester.*

21. ECONOMIC MILK PRODUCTION.—*Five times a week; second semester.* Professor FRASER.

HORTICULTURE

Courses for Graduates

Exceptional opportunity is afforded for exhaustive studies in problems concerning orchard management, spraying, packing, storing, and marketing of fruits and vegetables. There is also ample provision for research work in certain phases of landscape gardening and forestry.

At least two years of collegiate work in horticulture and allied subjects and the requisite preparation for the chosen subjects are required for entrance upon major work in this department.

101. POMOLOGY.—Studies of special problems regarding the relationship, adaptations, improvement, propagation, cultivation, pruning, protection, preservation or marketing of orchard fruits. Professor BLAIR, Associate Professor CRANDALL.

102. POMOLOGY.—Studies of special problems regarding the adaption, propagation, cultivation, and pruning of small fruits. Associate Professor CRANDALL.

103. OLERICULTURE.—Studies of special problems regarding the structure, cultural requirements, and improvements of vegetables. Assistant Professor LLOYD.

104. FORESTRY.—Problems in general forestry and investigation of forest growths. Professor BURRILL.

Courses for Graduates and Advanced Undergraduates

7. SPRAYING.—The theory and practice of spraying plants, embracing a study of materials and methods employed in the combating of insects and fungous diseases. *Five times a week; second half of second semester.* Assistant Professor LLOYD.

8. ORCHARDING.—A comprehensive study of pomaceous

fruits (apple, pear, quince), and drupaceous or stone fruits (plum, cherry, peach, nectarine, apricot). *Five times a week; second semester.* Associate Professor CRANDALL.

10. LANDSCAPE GARDENING.—A course in ornamental and landscape gardening with special reference to the beautifying of home surroundings. *Three times a week; first or second semester.* Assistant Professor WYMAN.

12. EVOLUTION OF HORTICULTURAL PLANTS.—Comprising a study of organic evolution and the modification of plants by domestication. *Five times a week; second half of first semester.* Associate Professor CRANDALL.

24. LANDSCAPE HORTICULTURE.—Exhaustive studies of ornamental plants and methods of grouping the same for the effective planting of public and private grounds. *Friday or Saturday; both semesters.* Assistant Professor WYMAN.

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THE GRADUATE SCHOOL

OF THE

UNIVERSITY OF ILLINOIS

ANNOUNCEMENT FOR

1911-1912

URBANA-CHAMPAIGN, ILLINOIS
PUBLISHED BY THE UNIVERSITY

LANGUM PEARSON CO.
CHAMPAIGN

UNION
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THE UNIVERSITY CALENDAR, 1911-12

As applicable to the Graduate School

First Semester, 1911-12

1911	
Sept. 18, 19, Monday and Tuesday	Registration days
Sept. 20, Wednesday, 8 a. m.	Intsruction begins
Oct. 2, Monday, 4 p. m.	Senate meeting
Nov. 1, Wednesday	Latest day for formal announcement to Dean of thesis subjects for master's degrees, doctor's degree, and professional engineering degrees
Nov. 29, Wednesday, 12 m.	Thanksgiving recess begins
Dec. 2, Saturday	Illinois Day
Dec. 4, Monday, 12 m.	Instruction resumed
Dec. 4, Monday, 4 p. m.	Senate meeting
Dec. 22, Friday, 12 m.	Christmas Holiday recess begins
Dec. 30, Saturday, 5 p. m.	Latest date for submission of outlines of proposed theses by candidates for professional degrees in engineering
1912	
Jan. 3, Wednesday, 12 m.	Instruction resumed
Jan. 25, Thursday, 8 a. m.	Semester examinations begin
Feb. 1, Thursday, 5 p. m.	First semester ends

Second Semester, 1911-12

Feb. 5, 6, Mon. and Tues.	Registration days
Feb. 5, Monday, 4 p. m.	Senate meeting
Feb. 7, Wednesday, 8 a. m.	Instruction begins
Feb. 12, Monday	Lincoln Day
March 12, Tuesday	Annual meeting of Board of Trustees

April 1, Monday, 5 p. m.	Latest date for filing completed theses by candidates for professional degrees in engineering
April 1, Monday, 4 p. m.	Senate meeting
April 4, Thursday, 12 m.	Easter recess begins
April 9, Tuesday, 12 m.	Instruction resumed
May 11, Saturday, 12 m.	Latest date for receipt by Dean of certified doctors' theses
May 30, Thursday	Military day
May 31, Friday, 8 a. m.	Semester examinations begin
June 1, Saturday, 12 m.	Latest time for receipt by Dean of certified masters' theses
June 9, Sunday	Baccalaureate address
June 10, Monday	Class day
June 11, Tuesday	Alumni day
June 12, Wednesday	Forty-first annual commencement

THE EXECUTIVE FACULTY

Of the Graduate School

Edmund Janes James, Ph. D., LL. D., President of the University.

Thomas Jonathan Burrill, Ph. D., LL. D., *Vice-President, Professor of Botany.*

David Kinley, Ph. D., LL. D., *Dean of the Graduate School and Professor of Economics.*

Albert Pruden Carman, A. M., Sc. D., *Professor of Physics.*

William Freeman Myrick Goss, D. Eng., *Dean of the College of Engineering, Director of the School of Railway Engineering and Administration and of the Engineering Experiment Station.*

Guy Stanton Ford, Ph. D., *Professor of Modern European History.*

George Abram Miller, Ph. D., *Professor of Mathematics.*

William Albert Noyes, Ph. D., *Professor of Chemistry and Director of the Chemical Laboratory.*

Julius Goebel, Ph. D., *Professor of Germanic Languages.*

Henry Baldwin Ward, Ph. D., *Professor of Zoology.*

Arthur Newell Talbot, C. E., *Professor of Municipal and Sanitary Engineering.*

Stuart Pratt Sherman, Ph. D., *Associate Professor of English and Chairman of the Committee of the Department of English.*

Boyd Henry Bode, Ph. D., *Professor of Philosophy.*

Herbert Windsor Mumford, B. S., *Professor of Animal Husbandry.*

James Harvey Pettit, Ph. D., *Assistant Professor of Soil Fertility.*

HISTORY AND ORGANIZATION

Although for many years the University of Illinois has offered advanced students facilities for study and research in various lines, graduate work was undertaken under the name of the Graduate School for the first time in 1892. In 1894 the administration of the school was vested in the Council of Administration and the Vice-President of the University became Dean of the School. In 1906 the Graduate School was organized as a separate faculty, consisting of a dean and members of the University faculty assigned to this duty by the President. No means of support, however, were provided, separate from those provided for undergraduate work. In the winter of 1906-7, the Forty-fifth General Assembly of the State passed an act appropriating $50,000 per year for the support of a Graduate School of the Arts and Sciences in the State University. This is the first time in history in which a State Legislature has made a specific appropriation for such a purpose and the act is noteworthy as committing a democratic government definitely to the promotion of advanced scholarship and research in subjects which are cultural as well as practical. The executive faculty was accordingly organized, and steps were taken to put certain departments in suitable condition to do advanced work.

By act of the Trustees the teaching faculty of the Graduate School includes all members of the University faculty who give instruction in courses approved for graduate credit. The affairs of the School, however, are in charge of the executive faculty appointed each year by the President.

ADMISSION

,For admission to the Graduate School to work for a degree an applicant must hold a first degree either from the University of Illinois or from some other university or college of approved standing. Admission to particular graduate courses or departments may be secured only by those who have had the requisite undergraduate work in those courses or departments. If any student wishes to take graduate work in a department in which he has not the necessary preliminary undergraduate training, he must secure this preparation in the undergraduate courses without credit towards an advanced degree.

In order to be enrolled as a member of the Graduate School a student must be doing graduate work. The possession of a first degree does not entitle a student to be enrolled in the Graduate School, if the courses which he is taking are undergraduate.

Students of mature age who do not hold a first degree, but satisfy the dean of the school and the officers of the departments in which they wish to work of their earnestness of purpose and special fitness, may be permitted to take work in the Graduate School without reference to candidacy for a degree. In order to secure this permission, however, a candidate must have had such preliminary preparation for the work he wishes to take up as would justify his admission to the Graduate School as a candidate for a degree if he could meet the formal requirements fully.

Application blanks for admission may be secured from the Dean of the Graduate School or from the Registrar of the University.

REGISTRATION

After the student's application for admission has been approved, he receives from the Dean a permit to register and also a study blank. This study blank must be filled out with the advice of the professor in charge of the selected work. The student must then pay his fees at the business office, secure a receipt therefor and return this receipt with the approved study blank to the Dean.

Each student is required to attend a minimum of four class, lecture, or laboratory, exercises, per week, in the first year of his

graduate study; and in no case is he permitted during his course to attend more than twelve per week.

Residence.—Continuous residence and study are required of all members of the Graduate School, unless they are granted leave of absence by the Dean, upon recommendation of the professors in charge of their work, for the purpose of carrying on elsewhere studies or investigation in the line of work for their degrees.

CHARACTER OF GRADUATE WORK

The principal aim of graduate study is the development of the power of independent work and the promotion of the spirit of research. Consequently, before he can get his degree, each graduate student is expected to show that he has acquired the power of independent research. In addition, each candidate is expected to have a wide knowledge of his subject and of related fields of work, for the graduate student is not expected to get from lecture and laboratory courses all the knowledge and training necessary to meet the requirements for his degree. The class, lecture, or laboratory course is intended to present the principles or theory of the subject and serve as a model or guide to the student in his private reading and research.

Students are warned against restricting themselves merely to the courses prescribed or suggested by the departments in which they are studying. Each student is expected to do a wide range of private reading and study; and in many cases will find it advisable to take one or more courses of lectures quite outside the field of his chosen subjects.

THE MASTERS' DEGREES

Candidates for the degree of Master of Arts or Master of Science are required to do at least one year's work in residence and to write a thesis.

A candidate for a master's degree may do all his work in one subject, or he may select a major and one minor, or a major and two minors. A major or minor denotes the field of knowledge of a department, or such part thereof as constitutes a separate and

independent division of that field. The candidate must do at least half his work in his major subject.

Each candidate for a master's degree is also required to present a thesis on some subject approved by the professor in charge of his major work and the Faculty of the School. The requirement of a thesis may be waived, however, upon the recommendation of the head of the department in which the student is doing his major work, and the approval of the Dean. Permission to take the degree without a thesis must be obtained *not later than the latest date for the approval of thesis subjects, as shown by he calendar.*

Credit is not given for work done in other universities. The candidate is examined here on the subjects offered by him for the advanced degree.

The Master's Degree in Engineering

Two classes of masters' degrees are open to graduates of the College of Engineering, namely, academic and professional.

The *academic* second degree in engineering is Master of Science, following Bachelor of Science, in Architecture, Architectural Engineering, Civil Engineering, Electrical Engineering, etc. This degree is conferred in accordance with the regulations described above *for academic work in residence only.*

The *professional* second degrees in engineering are as follows:

Master of Architecture after B. S. in Architecture.

Architectural Engineer after B. S. in Architectural Engineering.

Civil Engineer after B. S. in Civil Engineering or B. S. in Municipal and Sanitary Engineering.

Electrical Engineer after B. S. in Electrical Engineering.

Mechanical Engineer after B. S. in Mechanical Engineering.

Civil Engineer, Electrical Engineer or Mechanical Engineer, after B. S. in Railway Engineering, according to the course.

Professional degrees are conferred upon two classes of candidates: 1. Graduates of the College of Engineering of the University of Illinois who have been engaged in accepted professional work away from the University for a period of not less than three years after receiving the degree of Bachelor of Science. 2. Graduates of the University of Illinois, or of institutions of equal standing, who

have been engaged in acceptable professional work in residence at the University for a period of not less than three years after receiving the degree of Bachelor of Science.

In "acceptable professional work" may be included contributions to technical literature, activity in professional societies, investigations of engineering problems, and the teaching of engineeirng subjects.

A candidate must declare his candidacy and file with the Dean of the College of Engineering, as chairman of the committee in charge, a detailed statement covering his professional study and experience, not later than the first Monday in November preceding the commencement at which he proposes to qualify. Prior to December 31 next succeeding, he must submit for approval an outline of his proposed thesis, and he must file his completed thesis not later than April 1. If the statement of professional experience and study and the thesis are acceptable, the candidate must present himself at commencement in order to receive the degree.

Candidates for professional engineering degrees who already hold the degree of Master of Science, may qualify for the professional degree after two years of professional work.

THE DEGREE OF DOCTOR OF PHILOSOPHY

General Statement of Requirements.—The requirements for the degree of Doctor of Philosophy are a thorough mastery of a selected field of study, evidence of the power of independent investigation in this field, a broad knowledge of the wider field of study of which this major subject is a part, a general acquaintance with related fields of knowledge and a mastery of all branches of study which are necessary to a full knowledge of the main subject. Each student who is seeking this degree is expected to choose for study and final examination a major subject, or field of study, and a first and second minor. The major subject is the field in which the student expects to become expert and an authority. The first minor must be a subject closely related to the major and may, under certain conditions and with proper approval, be a sub-division of the major field of study. The second minor should be chosen outside of the major field of study.

When a candidate chooses any subject as his major, and a division of that subject as his first minor, he is not permitted to choose as a second minor any division of work in that same department, excepting by vote of the executive faculty of the School.

The candidate's list of subjects must receive the approval of the head of the department in which he chooses his major work and of the Dean of the School.

Period of Study.—The minimum period of study required for securing the degree of Doctor of Philosophy is three years, and if a candidate of ability enters the Graduate School fully qualified to take up immediately the work leading to a doctorate and devotes all his time to the pursuit of his purpose, he will usually succeed in getting his degree at the end of three years. The degree is conferred, however, not for residence during a certain period, but for scholarly attainments and power of investigation, as proved by thesis and examinations.

Candidates should note that credit is not given for work done in other universities, excepting in the sense that their residence at other institutions is counted towards the residence requirement for the doctor's degree.

At least the first two or the last one of the three years required must be spent at this University.

Examinations.—Towards the end of his second year of study, or, by special permission, at the beginning of his third year, the candidate for the degree must submit to a preliminary examination conducted by the members of the faculty with whom he is doing his principal work, in order to determine whether he will be accepted as a candidate for the degree in the following year. This examination is partly oral, and may be wholly so. At this time, or before, the candidate will be required to demonstrate his ability to read French and German, and any other language needed for the prosecution of his work. Excepting where the chosen field of study itself includes the languages, the examinations in languages are conducted simply to determine whether the student is able to use the languages as tools of investigation.

On or before the last Monday in May of the year in which the candidate expects to come up for his degree, he must submit

to a final examination by a committee appointed by the Dean of the Graduate School. This examination will be partly written. The candidate will also have, however, an oral examination. These examinations will not be confined to the courses which the candidate has attended in the University of Illinois only, if he has done part of the work elsewhere; nor even to the field covered by the courses specifically taken in this or other universities; but will be so conducted as to determine whether the candidate has a satisfactory grasp of his major subject as a whole, and a general acquaintance with the broad fields of knowledge represented by his course of study.

Before the candidate is admitted to the final examination and the defense of his thesis, he may be required to take any other examination, oral or written, that is thought proper by the various departments in which he has studied. If after having passed his preliminary examination, he fails in the third year of his study to meet the expectations of the professors in charge of his work, or in any way fails to maintain the standard of scholarship and power of research expected of him, he may be refused admission to the final examination.

The final examination in the major and minor subjects may not be divided. The examination must be taken all at one time even though it requires several sessions.

Thesis.—The power of independent research must be shown by the production of a thesis on some topic connected with the major subject of study. The candidate is expected to defend his thesis or dissertation before the members of the faculty, or as many of them as may wish to question him about it, in connection with his final examination.

The subject of the thesis should be chosen not later than the end of the second year of study and must be submitted for formal approval by the faculty not later than the first Monday of November of the year when the degree is expected. A typewritten copy of the completed thesis must be in the hands of the Dean not later than noon of May eleventh, or the day following, if the eleventh is a Sunday.

The thesis must be printed and one hundred copies deposited in the library of the University before the degree is conferred.

If, for any reason, the thesis cannot be printed and one hundred copies deposited before commencement time, the candidate must, before the first Monday in June, deposit a bond acceptable to the Comptroller of the University and the Dean of the Graduate School for the cost of printing his thesis, or such part thereof as may be regarded as sufficient to meet the requirements of the rules.

The title page of each thesis must bear the words "Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in—(here put the major subject), in the Graduate School of the University of Illinois." The title page must also contain the full name of the author, the full title of the thesis, the year of imprint, and, if a reprint, the title, volume and statement of the pagination of the volume from which it is reprinted. Each thesis must have an appendix giving a short educational history of the candidate, including the institutions he has attended, his degrees and honors, the titles of his publications, and such other matters as may be pertinent.

SCHOLARSHIPS AND FELLOWSHIPS

A number of fellowships and scholarships have been established by the Trustees of the University. To first year graduate students of ability and promise there are open a number of scholarships with a stipend of $250 each and freedom from tuition, incidental and laboratory fees. To second and third year graduate students, that is, those who have had one or two years of graduate study, there are open fellowships with a stipend varying from $300 to $500, with freedom from fees. The larger stipends are given only to students who are expected to take their degrees within the year. Each holder of a fellowship or scholarship must pay the matriculation fee of ten dollars, unless he holds a first degree from the University of Illinois, and also the diploma fee of five dollars on receiving his diploma.

Candidates for these scholarships and fellowships must be graduates of the University of Illinois, or of colleges or universities having equivalent requirements for bachelors' degrees.

Application must be made upon blanks to be obtained from the Dean of the Graduate School. These application forms should be

addressed to the Dean of the Graduate School as early as possible in February of the academic year preceding that for which the fellowship is desired.

Applications for the scholarships and fellowships should be accompanied with full information concerning the applicant, and with any written or printed essays or results of investigation which he can submit.

Applicants for fellowships are required to send the Dean of the Graduate School prompt notice of their acceptance or refusal; and to agree that, if accepted, the appointment will not be resigned to take a similar one in any other institution during the year for which it is awarded.

Nominations to fellowships are made upon the grounds of worthiness of character, scholastic attainments, and promise of success in the principal line of study or research to which the candidate proposes to devote himself.

Scholarships and fellowships are good for one year, but may be renewed for a second or a third year in special cases. An appointment as honorary fellow, without stipend, may be made as specified for paid fellowships in the case of any one who has shown distinguished merit in his work.

Fellows may be required to assist in laboratories or classes in furtherance of their training for careers as investigators or teachers.

Research Fellowships in the Engineering Experiment Station

The Engineering Experiment Station, devoted entirely to research, was established by action of the Board of Trustees, December 8, 1903. Its purposes are the stimulation and elevation of engineering education, and the study of problems of special importance to professional engineers and to the manufacturing, railway, mining, and industrial interests of the state and the country.

Ten fellowships, each of five hundred dollars a year, have been established in the Engineering Experiment Station. Applicants to whom these fellowships are awarded are required to agree to hold them for two years, devoting a part of their time to work in the Engineering Experiment Station of the Uni-

versity. Application for these fellowships should be made to the Director of the Engineering Experiment Station.

LIBRARIES

The general University library, the library of the State Laboratory of Natural History, that of the Agricultural Experiment Station, and that of the College of Law are all at the University in Urbana. The libraries of the College of Medicine and the School of Pharmacy are in Chicago.

The general University library contains 204,000 volumes and 45,000 pamphlets. The University has a subscription list of 1,967 periodicals. The library of the State Laboratory of Natural History contains 7,450 volumes and 18,200 pamplets. The library of the College of Law contains the Federal and State Reports, the leading textbooks, and a line of leading periodicals. The department of education has made a special collection of about 1,500 books and 3,550 pamplets, which are kept in the rooms of the department in University Hall. This collection contains a very good assortment of modern text books, and copies of the courses of study of nearly all the large city school systems.

The general library of the University is open daily, from 8 a. m. until 10 p. m. and on Sunday from 2 p. m. to 6 p. m.

The Mason Historical Library.—The valuable library of western history collected by Edward G. Mason, Esq., long president of the Chicago Historical society, is in the Public Library of the city of Champaign, and is accessible to University students.

The Dittenberger Classical Library.—The University has recently acquired the library of Wilhelm Dittenberger, Professor of Classical Philology in the University of Halle. This library contains 5,600 items and is especially valuable for the literary study of the classical languauges. It includes, in the best editions, the works of the poets and prose writers, both Greek and Latin, and numerous works on grammar and history of literature, with between four and five thousand dissertations and programs on special topics. In addition, there are many works dealing with the other departments of classical philology, as epigraphy, history of ancient peoples, archaeology, philosophy, history of art, geography, chronology, metric, etc.

The Heyne Library of Germanics.—The entire library of Professor Moritz Heyne of the University of Göttingen was bought in 1909. It contains about 5,200 volumes. The collection is rich in the general field of German philology and especially in lexicography. It has many rare first editions of works of German literature from the sixteenth, seventeenth and eighteenth centuries, and has sets of a number of rare periodicals. It is also rich in works upon the history of German civilization.

Other special library facilities of various departments are mentioned in connection with those departments.

FEES AND EXPENSES

Except as noted below, graduate students pay fees as follows:

Matriculation fee	$10.00
Incidental fee, each semester	12.00
Diploma fee	5.00

All graduate students who have not matriculated as undergraduates at the University of Illinois pay the matriculation fee on entrance.

All graduate students pay the diploma fee on being recommended for their degrees.

No tuition charge or incidental fee is made for graduate courses to scholars, fellows, or members of the corps of instruction or the staffs of the scientific bureaus or experiment stations, nor for undergraduate courses on their study lists if approved by the heads of the departments and by the Dean of the School as necessary or desirable for the proper completion of the work for the degree. Otherwise, graduate students who take undergraduate courses must pay the proper undergraduate fee.

Each student working in laboratories, or in the drafting or engineering classes, is required to make a deposit of from 50 cents to $10.00, to pay for chemicals and apparatus used, and for any breakage or damages. But no charges or deposits for laboratory materials are required from scholars, fellows, or from members of the corps of instruction or scientific staffs mentioned above.

Table board may be obtained at prices ranging from $4.00 per week.

Room rent, with two in a room, ranges from $2.50 per week.

THE GRADUATE CLUB

The Graduate Club is an organization of the graduate students and graduate faculty. Its purpose is to furnish an opportunity for those working in different departments to become acquainted with one another and thus counteract the tendency toward narrowness which graduate work often develops. The meetings are held at convenient intervals during the year. Some of these meetings are of a purely social character while at others informal addresses or papers are given.

DEPARTMENTS OF INSTRUCTION

Courses are offered in the following groups of subjects:

A. Languages and Literatures.
B. History and the Social Sciences.
C. Education, Philosophy and Psychology.
D. The Physical Sciences, including Mathematics.
E. The Biological Sciences.
F. Engineering.
G. Agriculture.

A. Languages and Literatures

THE CLASSICAL LANGUAGES

Greek

Preparation for graduate work in Greek should include two years of college Greek in addition to entrance requirements.

Courses for Graduates

103. Principles of Comparative Grammar.—This course may be counted either for Greek or Latin credit. *Three times a week; first semester.* Dr. Canter.

104. Homer and the Homeric Question. *Twice a week; both semesters.* Associate Professor Oldfather.

[Alternates with 105.—Not given in 1911-12.]

105. Plato and Aristotle. *Twice a week; both semesters.* Associate Professor Oldfather.

106. Greek Drama. *Twice a week; both semesters.* [Not given in 1911-12.] Professor Moss.

107. Greek Oratory. *Twice a week; both semesters.* Professor Moss.

108. Hellenistic Greek. (106, 107, and 108 are given in a three years' cycle.) *Twice a week; both semesters.* Professor Moss.
[Not given in 1911-12.]

Courses for Graduates and Advanced Undergraduates.

21. Beginning Greek.—Elementary Composition and Grammar; Lectures on Greek Literature. *Four times a week; both semesters.* Professor Moss.

Latin

Students desiring to take graduate work in Latin should have had at least three years of college Latin in addition to Latin presented to meet entrance requirements.

Courses for Graduates.

103. Cicero De Natura Deorum, and De Divinatione. *Twice a week; first semester.* Assistant Professor Pease.
104. Palaeography. *Once a week; first semester.* Assistant Professor Pease.
105. Latin Poetry. *Twice a week; second semester.* Assistant Professor Pease.
106. Comedy. *Twice a week; both semesters.* Associate Professor Oldfather.
107. Epigraphy. *Twice a week; second semester.* Assistant Professor Pease.
108. Tacitus, the Histories. *Twice a week; second semester.* Professor Barton.

Courses for Graduates and Advanced Undergraduates.

14. Seneca.—Selections from his Essays, Letters, and Tragedies. *Three times a week; first semester.* Professor Barton.
16. Martial and Suetonius.—Selections. *Three times a week; second semester.* Associate Professor Oldfather.

Philology

110. Introduction to Classical Philology.—This course is designed to make clear the aims and methods of Classical Philology, to outline the more important divisions of the subject, and to present the main sources of bibliographical material, together with selected bibliographies of certain special fields. Attention is given to the preparation of theses for advanced degrees. All graduate students who are taking Latin or Greek as a major for the doctor's degree must elect this course unless they already have completed it or its equivalent. *Once a week; both semesters.*

Associate Professor Oldfather and Assistant Professor Pease. [Not given in 1911-12.]

ENGLISH

The Degree of Master of Arts in English.—In addition to complying with the general rules of the Graduate School candidates for the degree of Master of Arts in English must comply with the following rules of the department of English:

Candidates must take, in addition to the courses required for the first degree (1) a certain number of courses "for graduates"; (2) an elementary course in Anglo-Saxon if such a course has not previously been taken. They may not include, for credit, English 1, 2, 15, 16, or 23, or any courses in rhetoric except 12, 15, 16, and 20, and must satisfy the department of their ability to write acceptable English.

As a rule, candidates must take the regular semester examinations in all their courses. They must also take special examinations as follows: a written examination, lasting about three hours, which must cover not only the field of the courses taken, but also the general fields of English and American literature and the outlines of the history of the English language: an oral examination which shall be a final test of the candidate's general fitness and ability.

The Degree of Doctor of Philosophy in English.—In addition to the general rules and suggestions for all candidates for the degree of Doctor of Philosophy the following departmental rules and suggestions are to be noted.

From the list of topics grouped below there must ordinarily be chosen:

By all:	the whole of G, H, and I, either 4 or 5 in Group A, Beowulf, Chaucer, Shakspere, and Milton.
By those whose main interest lies in Group B;	All of A, B, and C; 3 from D; 2 from E; 2 from F.
By those whose main interest lies in Group C:	3 from A; all of B and C; 4 from D; 2 from E; 2 from F.
By those whose main interest lies in Group D:	1 from A; 2 from B; 2 from C; all of D; 3 from E; 3 from F.
By those whose main interest lies in either Group E or Group F:	1 from A; 2 from B; 2 from C; 3 from D; all of E and F.

Group A

1. Gothic.
2. Old French.
3. Old Norse.
4. History and Principles of English Grammar.
5. History of the English Language.

Group B

1. Anglo-Saxon Language and Versification.
2. Anglo-Saxon Prose.
3. Beowulf.
4. Other Anglo-Saxon Poetry.

Group C

1. Middle English: Language.
2. Middle English Literature: Ballads.
3. Middle English Literature: Romances.
4. Middle English Literature: Chaucer.
5. Middle English Literature: Lydgate, Gower, Wyclif, etc.
6. Middle Scottish Language and Literature.

Group D

1. Drama before Shakspere.
2. Shakspere.
3. The Drama from Shakspere to 1642.
4. Elizabethan and Jacobean Non-Dramatic Poetry.

5. Elizabethan and Jacobean Prose.
6. Milton.

Group E

1. The Period of Dryden.
2. The Period of Pope.
3. The Period of Johnson.
4. American Literature to 1800.

Group F

1. The Earlier Romantic Movement.
2. The Period of Wordsworth.
3. The Period of Tennyson.
4. American Literature since 1800.

Group G

1. The History and Principles of Literary Criticism, especially of English Literary Criticism.
2. The History and Principles of English Versification.

Group H

1. English and American History in Outline.
2. A much more thorough knowledge of the history of England during the period upon which the candidate concentrates his attention. (If the candidate's special interest is in American literature, both English and American history will be required).
3. A fair knowledge of the history, during the period upon which the candidate concentrates his attention, of the country which is then most closely related to English literature.
4. A general knowledge of the history of modern philosophy.
5. A much more thorough knowledge of philosophy during the period upon which the candidate concentrates his attention, with special reference to England and to that country whose literary relations with England are closest at that time.

Group I

1. A reading knowledge of French and German.
2. A general knowledge of Greek and Latin literature and mythology.

3. A general acquaintance with that literature which during the period upon which the candidate concentrates his attention stands in closest relation to English literature.

Students who expect to enter upon graduate work with English as their major subject are required to have taken twenty hours of English literature. They should also have taken at least one elective course in English composition, and should have read liberally outside of their courses. A reading knowledge of either French or German, as well as some acquaintance with those literatures, is desirable, though not required. Valuable auxiliary studies are classics, history, and philosophy

Literature

Courses for Graduates

101. Research in Special Periods.—Competent graduate students are encouraged to seek the advice and assistance of the Department of English and to submit to the Department plans for study in the languages or literature of the periods mentioned below.

A. Anglo-Saxon Language and Literature.
Professor Dodge and Dr. Zeitlin.

B. Thirteenth and Fourteenth Centuries. Dr. Jones.

C. Sixteenth Century. Professor Dodge.

D. Seventeenth Century.
Professor Alden and Assistant Professor Baldwin.

E. Eighteenth Century.
Associate Professor Sherman and Assistant Professor Paul.

F. Nineteenth Century.
Associate Professor Fulton and Associate Professor Sherman.

102. Seminary in Comparative Literature.—Subject for 1911-12: Tragedy.—*Twice a week; both semesters.* Professor Alden.

109. German and Scandinavian Influences on English Literature of the Eighteenth and Nineteenth Centuries. *Twice a week; second semester.* Professor Dodge.

110. Anglo-Saxon Poetry.—*Twice a week; both semesters.*—Professor Dodge.

112. The History and Principles of English Grammar.—*Twice a week; both semesters.* Dr. Zeitlin.

113. English Prose Syntax.—An historical study of the forces (Old English, Old French, Latin) at work in the development of the English sentence, and an analysis of the style of important prose writers from the syntactical point of view. *Twice a week; both semesters.* Dr. Zeitlin.

[Not given in 1911-12].

126. English Ballads and Metrical Romances.—Students who elect English 126 are advised to take either with or before it English 7 (Chaucer) and Romance Languages 102 (Old French). *Twice a week; both semesters.* Dr. Jones.

[Not given in 1911-12].

127. Middle English.—Critical Reading of Middle English texts. *Twice a week; both semesters.* Dr. Jones.

136. The Transition From the Seventeenth to the Eighteenth Century in English Literature.—*Twice a week; both semesters.* Assistant Professor Paul.

137. Nineteenth Century Prose Writers.—*Twice a week; both semesters.* Associate Professor Sherman.

[Not given in 1911-12].

138. The Romantic Movement in England.—The attention of students who wish to take English 138 is called to History 7 (The Revolutionary and Napoleonic Era).—*Twice a week; both semesters.* Associate Professor Sherman.

Courses for Graduates and Advanced Undergraduates

3. The Poetry of Milton.—*Twice a week; both semesters.* Assistant Professor Baldwin.

4. The History and Principles of English Versification.—Theory of English metre and rhythm; history of the development of the forms of English verse. *Twice a week; first semester.* Professor Alden.

5. Shakspere and his Predecessors.—The second semester,

which will be devoted to Shakspere, may be taken without the first. *Three times a week*; *both semesters.* Professor Dodge.

6. English Literary Criticism.—A general survey of the history of English literary criticism from the beginning of the Elizabethan to the beginning of the Victorial period. A brief discussion of Greek and Latin criticism will preface the main work of the course. *Three times a week*; *both semesters.*

Associate Professor Fulton.

7. Chaucer.—*Three times a week; both semesters.*

Dr. Jones.

8. Old English (Anglo-Saxon).—Grammar, prose, short poems, *Beowulf*. *Three times a week*; *both semesters.*

Professor Dodge.

11. The Principles of Criticism.—A disussion of some of the more notable theories of art, the nature and elements of literature, and the meaning and purpose of criticism. Students who take English 11 are advised to take either before or with it Philosophy 8 (Esthetics). *Twice a week*; *first semester.*

Associate Professor Fulton.

17. The History of the English Language.—*Three times a week*; *both semesters.* Associate Professor Fulton.

35. The Drama from 1600 to 1900.—Either semester may be taken without the other. *Three times a week; both semesters.*

Associate Professor Sherman, Mr. Guild.

40. Lyrical Poetry of the Elizabethan Age and Seventeenth Century.—*Three times a week; both semesters.*

Professor Alden.

Composition

Courses for Graduates and Advanced Undergraduates

6. Advanced English Composition.—This course is intended for those who have some aptitude for literary work. The work of the course will consist chiefly in the study and practice of short story writing. *Three times a week; first semester.* Mr. Guild.

15. Advanced Newspaper Writing.—In the first semester this course takes up for study the more important problems in reporting.

In the second semester an effort is made to apply the principles of history, economics, political science, etc., to public events. Copy reading, head writing, editing, and editorial writing are studied and practiced. *Three times a week; both semesters.* Mr. Scott.

17. English Composition.—This course is intended only for students with a definite purpose and a special interest in composition. *Three times a week; second semester.* Professor Alden.

GERMANIC LANGUAGES

German

Students desiring to take German as a major are expected to have finished successfully a four years' course of undergraduate work in German, corresponding to the four years' course in German at this University. They are expected to be familiar with the principal works of the writers of the classical and modern periods of German literature, to show a general knowledge of the history of German literature and to have the ability of following lectures in the German language.

Of collateral subjects, a reading knowledge of Latin and French is required. It is desirable that candidates for the degree of Ph. D. have some knowledge of Greek. All students are expected to have had a course in German History.

Courses for Graduates

101. Seminary in Germanic Philology.—The work is adapted to the abilities and tendencies of the students. The primary object is to give training in original research. The result of the work, when of value, may be published in the *Journal of English and German Philology*. The subject for 1911-12 will be Herder. *Once a week; both semesters.* Professor Goebel.

103. Introduction to the Historical Study of the Germanic Languages.—Lectures; discussions of special topics. History of German Philology. Comparative Grammar of the Old Germanic dialects. *Twice a week; second semester.* Professor Goebel.

104. Gothic.—An introductory study of its grammar and literature. *Twice a week; first semester.* Professor Goebel.

105. Old High German.—Grammar and interpretation of the texts. *Twice a week; second semester.* Dr. Bloomfield.

109. Goethes und Schillers Philosophische Weltanschauung.—*Twice a week; both semesters.* Professor Goebel.

[Not given in 1911-12.]

110. Early German Drama.—The development of the German drama up to the Reformation, including the medieval religious drama, the Shrovetide plays and the beginnings of the Humanistic drama. *Twice a week; first semester.*

Assistant Professor Brooks.

113. German Literature of the Fifteenth and Sixteenth Centuries.—Survey of the literature on the background of the general history of the time. Luther and the Reformation, Mastersingers and Folksong, the Reformation drama, Hans Sachs, Brant, Fischart, the chap books, the English comedians. *Three times a week; second semester.* Assistant Professor Brooks.

115. History of German Literature from Goethe's Death to the Present Time.—*Twice a week; both semesters.*

Associate Professor Lessing.

116. History on Literary Criticism in Germany. — *Three times a week; second semester.* Associate Professor Lessing.

117. History of German Literature During the Eighteenth Century.—*Twice a week; both semesters.*

Professor Goebel.

118. Studies in the History of the German Drama with Special Reference to Kleist and Grillparzer.—*Both semesters.*

Associate Professor Lessing.

119. The Modern German Novel.—*Once a week; both semesters.* Associate Professor Lessing.

121. Walther von der Wogelweide. Lectures and Interpretations.—*Twice a week; second semester.* Professor Goebel.

123. The Romantic School.—The course deals with the literary side of early Romanticism in Germany. Lectures and reports. *Twice a week; first semester.* [Not given in 1911-12.]

124. History of the Drama.—Brief survey of the beginnings and earlier development, followed by a more intensive study of the drama in the eighteenth century. *Twice a week; first semester.*

Assistant Professor Meyer.

Courses for Graduates and Advanced Undergraduates

8. SCHILLER.—The life of Schiller and study of Wallenstein and other selections. *Three times a week; first semester.* Associate Professor LESSING.

9a. GOETHE'S FAUST.—The Faust legend and early Faust books and plays, the genesis of Gothe's Faust, reading of both parts. *Twice a week; both semesters.* Professor GOEBEL.

9b. GOETHE-SCHILLER.—Interpretation of Goethe's poems, Tasso and Schiller's Ueber naive and sentimentalische Dichtung. *Twice a week; both semesters.* Professor GOEBEL.

11. GERMAN LITERATURE AFTER THE REFORMATION.—Lectures, recitations and reports on assigned collateral reading. *Three times a week; second semester.* Associate Professor LESSING.

26. GERMAN LITERATURE BEFORE THE REFORMATION.—Lectures, recitations, and reports on assigned reading. *Three times a week; first semester.* Associate Professor LESSING.

27. LESSING.—The life of Lessing and study of Nathan der Weise, Emilia Galotti, and other selections. *Three times a week; second semester.* Associate Professor LESSING.

29. ADVANCED PROSE COMPOSITION.—An advanced teachers' course aiming to give some facility in idiomatic expression in speaking and writing German. Themes on Germany and German life, based on suitable reading, discussed in German. *Twice a week; both semesters.* Dr. KOLLER.

30. MIDDLE HIGH GERMAN.—Grammar and interpretation of the selected texts. Open to seniors; especially recommended to candidates for teachers' certificates. *Twice a week; first semester.* Professor GOEBEL.

SCANDINAVIAN LANGUAGES

Preparation for graduate work in Scandinavian philology should include a general introduction to Germanic philology, such as is contained in a course in Gothic and Old English. However, a student who has, through systematic work, attained a high degree of efficiency in one of the modern Scandinavian languages may

pass on to graduate work in Scandinavian Philology with the introductory work in Germanic philology. Preparation for graduate work in literature should include a thorough reading knowledge of the language and systematic work in the undergraduate courses in Scandinavian or the equivalent of these in other colleges.

Courses for Graduates

101. Old Norse.—Introduction to the language as a member of the Germanic group. Reading of the Volsungasaga with selections from the heoric lays. *Twice a week; both semesters.*
Assistant Professor Flom.

102. Old Danish.—Introduction to the language. Reading of selections from the oldest texts and from ballads. *Twice a week; first semester.* Assistant Professor Flom.

103. Old Swedish.—Introduction to the language. *Noreen's Altschwedische Grammatik* and *Lesebuch* will be used. *Twice a week; second semester.* Assistant Professor Flom.

110. Advanced Old Norse.—A critical study of all the lays of the *Elder Edda,* with selections from the *Thithreks saga* and the *Njals saga. Twice a week; both semesters.*
Assistant Professor Flom.

Course for Graduates and Advanced Undergraduates

11. Survey of the History of the Swedish Languages and Literature.—Lectures. Assistant Professor Flom.

ROMANCE LANGUAGES

Before entering upon the study of Romance Languages for an advanced degree, the candidate should have had a total of at least thirty hours of college work in these languages. Eighteen of these hours must be in one of the three languages, French, Italian, or Spanish, but no candidate will be received who has not had at least twelve hours of French. In addition a candidate should have had good training in Latin, and be able to read ordinary German prose.

French

102. Old French Readings.—First semester: Chrétien de Troyes and the court epic. Second semester: Readings from Marie de France, the prose chroniclers and the dramatists of the middle ages. *Twice a week; both semesters.* Professor Oliver.

103. Old French Phonology and Morphology.—Development of Old French from Vulgar Latin. *Twice a week; both semesters.* [Not given in 1911-12.] Associate Professor Carnahan.

110. Old Provençal.—The language and literature. The early lyric poetry of the north of France is studied also in this course. *Twice a week; both semesters.* [This course is conducted in French.] Assistant Professor Beck.

112. Introduction to Romance Philology. — *Once a week; both semesters.* Assistant Professor Fitz-Gerald.

125. Seminary.—An opportunity is given here for research in special fields of French and other Romance literatures.

Courses for Graduates and Advanced Undergraduates

10. General Survey of French Literature.—An introduction to more extended study of special periods and authors. The literary masterpieces of France; the main currents of French literature from the beginning to the present time. *Three times a week; both semesters.* Associate Professor Carnahan.

This course is strongly recommended to those who desire the endorsement of the department to teach French.

22. Modern French Literature.—A study of French literature from the beginning of the nineteenth century to the present time. Lectures, collateral reading and reports. *Three times a week; both semesters.* [This course is conducted in French.] Assistant Professor Beck.

24. French Literature of the Seventeenth and Eighteenth Centuries.—A study of the greater masterpieces of literature of the seventeenth and eighteenth centuries in France. *Three times a week; both semesters.* Professor Oliver.

Spanish

Courses for Graduates

119. General Survey of Spanish Literature.—An introduction to more extended study of special periods and authors. *Once a week; both semesters.* Dr. Seymour.

121. Oldest Monuments of the Spanish Language.—Historical Grammar and palaeography. *Once a week; both semesters.* Assistant Professor Fitz-Gerald.

122. Origin of the Spanish Drama.—Lectures and private reading. *Once a week; both semesters.* [Not given in 1911-12.] Assistant Professor Fitz-Gerald.

Courses for Graduates and Advanced Undergraduates

11. The Spanish Drama of the Sixteenth and Seventeenth Centuries. — *Encina, Torres Naharro, Lope de Vega, Lope de Rueda, Tirso de Molina, Calderon, Ruiz de Alarcon, Moreto, Rojas Zorilla; Schack's Dramatic Literature. Twice a week; both semesters.* Dr. Seymour.

12. The Novela of the Golden Age.—A study of the political and social conditions in Spain from 1560 to 1700 will be followed by an examination of the various kinds of prose fiction produced in this period, with special attention to *Don Quijote* and the *Novelas Ejemplares* of Cervantes. *Three times a week; both semesters.* [Not given in 1911-12.] Assistant Professor Fitz-Gerald.

Italian

Course for Graduates and Advanced Undergraduates

2. Literary Course.—First semester: Rapid reading from the works of the principal Italian writers of the nineteenth century. Second semester: Dante. The *Vita Nuova* and the *Inferno.* Selected stories from Boccaccio *Decameron. Twice a week; both semesters.* Dr. Jones.

B. History and the Social Sciences

ECONOMICS

Every student entering upon graduate work in economics must have had a thorough course in the principles of the science and should also have studied some special part of the field of economics, such as public finance or money and banking.

The department of economics includes general economics, economic history, finance, commerce and industry.

Complete sets of all the important French, German, English, and American economic and financial journals are on hand; ninety periodicals, foreign and domestic, in economics, finance, commerce, industry, statistics, etc., are currently received. The library is unusually strong in railroad literature, economic history, labor, finance and general theory.

Courses for Graduates

101. Economic Theory.—*Twice a week; both semesters.* [Not given in 1911-12.] Professor Kinley.

103. Seminary in Railway Administration.—Advanced students in this subject make an investigation of some aspect of railway administration. *Once a week; both semetsers.* Professor Dewsnup.

104. Seminary in Commerce.—A study of present international commercial relations, with special reference to the trade conditions of the United States and the extension of her trade in foreign markets. *Once a week; both semesters.* Dr. Litman.

105. Public Finance.—The history and theory of public revenue and expenditure. *Twice a week; both semesters.* Associate Professor Bogart.

106. A: History of the Railway Development of the United States. B: The State and the Railway. C. Foreign Railway Systems.

The cycle of topics requires three years for the completion of the course. The topic in 1911-12 is A. *Once a week; both semesters.* Professor Dewsnup.

107. The Corporation in Economic Evolution.—*Once a week; both semesters.* [Not given in 1911-12.] Professor Robinson.

109. Theory of Industrial Consolidations.—The nature of industrial consolidations; the conditions and causes responsible for their development and their effects upon the production and distribution of wealth. *Once week; both semesters.* Professor Robinson.

112. Labor Probelms.—The history, structure and policies of labor organizations. Labor legislation, etc. *Twice a week; second semester.* Dr. Towles.

117. Economic History of Agriculture.—General characteristics of agriculture and its development as an industry in various countries at various times. Land tenure and landed property. Large, medium and small farms or estates. Economic conditions and results of extensive and intensive culture. Agricultural credit and markets. Agricultural labor. State of the agricultural class. Organization in agriculture. Relation of agriculture to other industries. Relation of the state to agriculture. General aspects of farm organization and management. *Twice a week; second semester.* Dr. Thompson.

118. Seminary.—The special subject of study for 1911-12 will be announced in due course. Members of the Staff.

120. History of Economic Thought.—*Twice a week; first semester.* Dr. Thompson.

122. Advanced Economic History of the United States.—*Twice a week; both semesters.* Associate Professor Bogart. [Not given in 1911-12].

Theory of Statistics.—See Mathematics 129.

Courses for Graduates and Advanced Undergraduates

4. Financial History of the United States.—A study of colonial and federal finance, including currency, banking, tariff and fiscal questions and a brief survey of the development of the

financial systems of some of the leading states, as New York and Illinois. *Three times a week; first semester.*

Assistant Professor WESTON.

[Not given in 1911-12].

5. PUBLIC FINANCE.—Public debts, revenue, taxation, etc. *Three times a week; first semester.* Associate Professor BOGART.

8. THE MONEY MARKET.—An advanced study of dealings in money and credit, the functions of money broker and banker, the concentration of financial dealings at such centers as New York and London, international payments and the determination of rates of foreign exchange, the seasonal demands for money, causes of fluctuation in rates of discount, monetary panics and crises, investments, and the financial aspects of dealings on the stock and produce exchanges. *Twice a week; second semester.*

Assistant Professor WESTON.

9. BANKING.—This is a course in the study of practical banking with special reference to the United States. *Twice a week; first semester.* Assistant Professor WESTON.

10. CORPORATION MANAGEMENT AND FINANCE.—*Three times a week; first semester.* Professor ROBINSON.

11. INDUSTRIAL CONSOLIDATION.—The development of industrial consolidations; the growth of monopoly; monopoly prices and methods; the ability of trusts to affect prices, wages, interest and profits; and the proposed plans for controlling trusts. *Three times a week; second semester.* Professor ROBINSON.

12. THE LABOR PROBLEM.—*Three times a week; first semester.* Dr. TOWLES.

13. ECONOMIC HISTORY OF EUROPE.—*Three times a week; second semester.* Associate Professor BOGART.

21. SOCIALISM AND SOCIAL REFORM.—*Three times a week; second semester.* Dr. TOWLES.

29. FOREIGN COMMERCE AND COMMERCIAL POLITICS.—A study of the various commercial systems, mercantile, free trade and protective, etc. *Three times a week; second semester.*

Assistant Professor LITMAN.

30. TARIFF AND CUSTOMS REGULATIONS OF THE UNITED STATES.—*Three times a week; first semester.*

Assistant Professor LITMAN.

35. CONSULAR AND DIPLOMATIC SERVICE.—The basis of this

course is the consular and diplomatic relations of the United States. Some attention, however, is paid to the foreign service of other important countries. *Three times a week; second semester.*

Assistant Professor LITMAN.

36. ORGANIZATION OF OCEAN COMMERCE.—*Three times a week; first semester.* Assistant Professor LITMAN.

41. RAILWAY TRANSPORTATION.—A study of the more general aspects of railway transportation in the United States, with references to conditions abroad. *Three times a week; first semester.*

Professor DEWSNUP.

42. RAILWAY ORGANIZATION AND FINANCIAL ADMINISTRATION.—A more specialized study of these topics, treated under the following heads; (1) Economics of railway location; (2) Types of organization (a) in the United States, (b) abroad; (3) The divisional, departmental, and unit systems of organization; (4) Officers, their duties and qualifications, (5) Methods by which uniformity and efficiency of working are secured, (6) Intercorporate relationship, (7) Reorganization. *Three times a week; second semester.*

Professor DEWSNUP.

43. THE THEORY AND PRACTICE OF RAILWAY ADMINISTRATION.—A description of the methods of traffic management and a discussion of the principles upon which they are based. *Twice a week; both semesters.* Professor DEWSNUP.

THEORY AND PRACTICE OF STATISTICS.—See Mathematics 23a and 31.

ACCOUNTANCY

Courses for Graduates and Advanced Undergraduates

4. ADVANCED ACCOUNTING.—This course includes the consideration of the handling of capital, revenue, dissolution of partnership, realization, liquidation, insolvency, good-will, treatment of bad debts, suspense, maintenance, depreciation, reserve, and sinking funds, contingent funds, secret reserves and the like. *Three times a week; second semester.* Assistant Professor DUNCAN.

5. AUDITING.—Discussion of the duties and responsibilities of an auditor, the kinds of audits that can be made, the value of each,

the auditor's report, what it should contain, his certificate, its value, the preparation of audit reports. *Twice a week; second semester.* Assistant Professor DUNCAN.

6. RAILROAD ACCOUNTING.—The handling of railroad revenue accounts, including freight, passenger, express and other earnings from the road and allied companies, the treatment of operating expenses, fixed charges, the work of the Interstate Commerce Commission in standardizing railway accounting methods. *Twice a week; second semester.* Assistant Professor DUNCAN.

7. ADVANCED ACCOUNTING PROBLEMS.—This course is a continuation of Accountancy 4. It includes the working out of practical problems involving the application of accounting theory. In this course are also briefly considered the special topics of executor accounts, insurance accounts and accounting for municipalities and other public bodies. *Three times a week; second semester.*

Assistant Professor DUNCAN.

HISTORY

Advanced courses in history at the University of Illinois are of three kinds : 1. Instruction in methodology, histography, and bibliography. This work is done at present by the co-operation of various instructors in course 103 described below, and is required of all graduate students in history during their first year. 2. Seminary courses for the study of special fields with a view primarily to training in the methods of historical criticism and research. 3. Courses for information and guidance in general reading.

Research or seminary work in history is offered in the following fields: Medieval history, English history with emphasis upon medieval institutions and the eighteenth century; modern European history with special reference to the rise of Prussia and the revolutionary and the Napoleonic era; American history with special reference to institutions and western development; the history of Latin America. Research topics in these special fields will commonly be arranged in cycles so that a new topic may be taken up in each of the three years devoted to graduate work.

A student entering upon graduate work should have had at least the equivalent of the introductory college courses in En-

lish, Continental European, and American history. Emphasis is laid upon linguistic preparation. All historical students should have at least a reading knowledge of German and French; for medieval history some knowledge of Latin is indispensable, and in certain fields of American history Spanish is needed. The requisite reading knowledge of French and German should be secured before the student enters on his second year of graduate work.

As illustrating the resources of the library for historical purposes the following items may be noted: In American history there are strong collections of colonial and federal documents and of the writings of statesmen, and such periodicals as Niles' Register. As the result of recent acquisitions the collection is especially rich in contemporary material dealing with the American revolution and the history of the West in the eighteenth century. In English history there are such standard sets as the Statutes of the Realm, the Parliamentary Debates, the Rolls Series, the Calendars of State Papers, and the Reports of the Historical Manuscripts Commission. The library has also purchased recently some of the important collections in the field of Continental European history. A valuable addition to the resources of the department is the library of western history collected by the late Edward G. Mason, a former president of the Chicago Historical Society. This library now constitutes the Mason Collection of the Champaign Public Library. Attention is also called to the fact that the University of Illinois has for some time co-operated with the Illinois State Historical Society and the trustees of the State Historical Library, in the gathering and editing of archive material. As a result of this relation instructors and graduate students in the department have, from time to time, contributed to the publications of these state organizations and have been given useful training in the study of manuscript as well as printed material.

As a means of mutual stimulus the Historical Club has been organized, consisting of instructors and graduate students in the department. The monthly program is devoted to reviews of current progress in historical work and from time to time members report the results of their own investigations.

Courses for Graduates

101. Seminary in American History.—The work of this course consists partly of general exercises in which all the members of the class are expected to take part. In these exercises some attention will be given to the general bibliography of American history; but a large part of the time will be devoted to the co-operative study of typical problems. During the first semester of 1911-1912 these problems will be selected from the history of the American colonies; during the second semester the topics will be selected from the field of western history. At the option of the instructors and the students this course may also include the preparation of a thesis based upon the results of research. *Two hours, once a week; both semesters.*

Professor Greene, Associate Professor Alvord, Dr. Buck.

102. Studies in English History.—The purpose of this course is to provide an opportunity for a closer study of some of the more important periods and movements of English history. *Twice a week; both semesters.* Assistant Professor Larson.

103. Historical Bibliography and Criticism.—Selected problems in various fields are worked out under the guidance of the several instructors. Required of all candidates for an advanced degree in history who do not present evidence of similar training elsewhere. *Twice a week; both semesters.* Dr. Paetow and others.

104. Seminary in Modern European History.—The subject selected for 1911-12 is the diplomatic relations between France and Prussia in the period of the French Revolution. *Both semesters.*

Professor Ford.

105. The History of Western Expansion, 1763-1818.— The period indicated is covered by lectures and readings, but the main object of the course is the study of various problems in the interpretation of western history. *Once a week; both semesters.*

Assistant Professor Alvord.

106. The Formation and Development of Brandenburg-Prussia from 1640 to 1786.—This course gives an opportunity, for somewhat detailed study of the work of the Great Elector, Frederick Wil-

liam I., and Frederick the Great. *Twice a week; both semesters.* Professor FORD.

[Not given in 1911-12].

107. SELECTED TOPICS IN THE HISTORY OF THE NINETEENTH CENTURY.—This course does not aim at a connected presentation of the whole period, but certain events, persons, and movements are selected for intensive study. Graduate students taking this course, who have not had the equivalents of History 7 and 20, will be expected to attend the exercises in those courses. *Twice a week; both semesters.* Professor FORD.

110. THE SPANISH-AMERICAN REVOLUTION.—A detailed study of the movement which culminated in the independence of the Spanish-American states. *Two hours, once a week; first semester.* Assistant Professor ROBERTSON.

111. THE SPANISH-AMERICAN DIPLOMACY.—A consideration of the problems which have arisen in the relations of the leading Spanish-American states with Europe and the United States. *Two hours, once a week; second semester.* Assistant Professor ROBERTSON.

History 110 and 111 are open only to students who possess a reading knowledge of the Spanish language.

112. SELECTED TOPICS IN THE HISTORY OF THE AMERICAN COLONIES IN THE EIGHTEENTH CENTURY.—*Two hours a week; second semester.* Professor GREENE.

[Not given in 1911-12].

113. SEMINARY IN MEDIEVAL EUROPEAN HISTORY.—The spread and influence of the medicants in medieval universities. *Twice a week; both semesters.* Dr. PAETOW.

Courses for Graduates and Advanced Undergraduates

(The ability to use French and German is desirable in most of these courses and is essential in some of them).

4. CONSTITUTIONAL HISTORY OF ENGLAND.—During the first semester the emphasis is placed on institutional origins; in the second semester particular attention is given to modern constitutional practice. *Three times a week; both semesters.* Assistant Professor LARSON.

8. MEDIEVAL CULTURE.—The main object of this course is to

trace the intellectual development of medieval civilization. In the period of transition from pagan to Christian culture typical figures like St. Augustine, Boethius, and Gregory the Great are studied in some detail. In the twelfth and thirteenth centuries prominence is given such topics as the strife over investitures, the crusades, vernacular literature, development of Gothic architecture, rise of universities, and scholasticism. *Three times a week; first semester.*

Dr. PAETOW.

9. THE ERA OF THE RENAISSANCE.—This course deals with the political, religious, and economic history of Europe during the fourteenth and fifteenth centuries as well as the intellectual and artistic revival. It is designed to be a continuation of course 8, although either may be taken separately. *Three times a week; second semester.* Dr. PAETOW.

[Not given in 1911-12].

10. HISTORY OF FRANCE IN THE MIDDLE AGES TO 1483.—The main stress is laid on the development of monarchial institutions and the growth of a national spirit. *Three times a week; second semester.*

Dr. PAETOW.

12. THE HISTORY OF GERMANY.—A general survey of German history to the formation of the present empire. Special attention is paid to the rise of Prussia. A reading knowledge of German or French is required. *Twice a week; both semesters.*

Professor FORD.

13. AMERICAN REVOLUTION, 1760-1783.—The following topics will be considered: The American people and their institution at the close of the colonial era; the causes of the Revolution, 1760-1775; a survey of the war period, 1775,1783. with special exphasis on the economic, social, and political changes, rather than upon military and diplomatic transactions. *Twice a week; first semester.*

Professor GREENE.

[Not given in 1911-12].

14. THE MAKING OF THE FEDERAL CONSTITUTION.—This course provides for an intensive study, based upon original material, of the events from 1783-1789 which resulted in the framing and ratification of the federal convention of 1787, and of the contemporary argu-

ments for and against the ratification of the Constitution. *Twice a week; first semester.* Professor GREENE.

[Not given in 1911-12].

15. AMERICAN HISTORY, 1841-1865.—Expansion, slavery, sectionalism, and the Civil War. *Twice a week; second semester.* Dr. BUCK.

16. THE HISTORY OF THE EXPLORATION AND COLONIZATION OF THE WEST FROM THE EARLIEST TIMES TO 1818.—The struggle of France, Great Britain, Spain, and the United States for the possession of the West. Special attention is given to the colonial policy followed by each nation. *Twice a week; first semester.* Associate Professor ALVORD.

17. THE HISTORY OF ILLINOIS FROM 1818 TO 1870.—This course is in a measure a continuation of History 16, and the subject is treated not from a purely local point of view, but as an illustration of the development of a typical commonwealth in the Middle West. *Twice a week; second semester.* Associate Professor ALVORD.

21. THE HISTORY OF THE UNITED STATES SINCE THE CIVIL WAR.—Historical introduction to contemporary American politics. *Three times a week; first semester.* Assistant Professor ROBERTSON.

26. THE HISTORY OF THE LATIN-AMERICAN COLONIES.—The political, economic, social, and intellectual life of Spain during the period of discovery; the exploration, settlement and civilization of Spanish America and the Philippines. Some attention is also given to the exploration and colonization of Brazil. *Twice a week; first semester.* Assistant Professor ROBERTSON.

27. HISTORY OF LATIN-AMERICA FROM THE WAR OF INDEPENDENCE TO THE PRESENT TIME.—The national history of the leading Latin-American states with special attention to political parties, existing governments, and the relations with Europe and the United States. A study of the old regime in Texas, Mexico and California. *Twice a week; second semester.* Assistant Professor ROBERTSON.

POLITICAL SCIENCE

Graduate work in political science embraces the following special fields: (1) Comparative Government; (2) Public Administra-

tion and Administrative Law; (3) International Law and Diplomacy; (4) Constitutional Law; and (5) Political Theory.

No student is considered qualified to carry graduate work in political science who has not had at least the equivalent of the introductory college courses in government and history. A reading knowledge of German and French is highly desirable and in some of the courses it is indispensable. Attention is called to the fact that recently extensive additions to the library equipment have been made so that the facilities for research work in political science are now believed to be ample for ordinary purposes.

Courses for Graduates

101. Municipal Administration.—This is an advanced course dealing with the development of cities, the organization of municipal government and its relation to the central government, and political methods and reform movements in cities.

An examination is also made of municipal functions in the United States and Europe, including police, fire, and health departments, schools, and charities, municipal public works, street railways, lighting plants, etc. *Three times a week; second semester.*

Associate Professor Fairlie.

102. The Nature of the State.—The principles, methods, and relations of political science; the origin, nature, forms, and functions of the state; sovereignty and liberty; citizenship and nationality; constitutions, principles of political organization, etc. *Twice a week; first semester.* Professor Garner.

[Not given in 1911-12].

103. Seminary in Political Science and Public Law.—Research work in the investigation of special problems. Presentation of reports followed by discussion and criticism. The research work of candidates who are writing theses will be under the personal supervision of some individual instructor to whom the candidates will be expected to report from time to time. *Both semesters.*

Conducted by the members of the department.

Courses for Graduates and Advanced Undergraduates

2a. British Government.—Political institutions in the United

Kingdom and the British Possessions, including the Crown, the Cabinet, the House of Commons, and the House of Lords, the party system, the courts of law, local government, and government in the Crown Colonies and the self-governing Colonies. Attention will be given to recent developments and proposed changes. Open to graduate students and to seniors who have had six hours in political science. *Three times a week; first semester.*

Associate Professor FAIRLIE.

2b. CONTINENTAL EUROPEAN GOVERNMENT.—A comparative study of the national political system of France, Germany, Italy, Austria-Hungary and Switzerland, with special reference to constitutional beginnings, political organizations, methods of legislation and administration, and constitutional guarantees for the protection of individual rights. *Three times a week; second semester.*

Dr. DODD.

5. CONSTITUTIONAL LAW OF THE UNITED STATES.—A study of judicial interpretation; judicial power to declare laws unconstitutional; separation of governmental powers; relation between the state and federal governments; fundamental rights under the constitution; territories and dependencies; federal powers with respect to taxation and commerce; jurisdiction of federal courts; etc. *Three times a week; first semester.* Dr. DODD.

6. INTERNATIONAL LAW.—The development of the law of nations; its nature, source, and present status; the equality of states; the doctrine of intervention; the law of war and peace; the rights and duties of neutrals; the arbitration movement. Lectures, assigned reading and reports. *Three times a week; first semester.*

Dr. MATHEWS.

7. AMERICAN DIPLOMACY.—A study of genesis and present organization of the Department of State; the diplomatic service; the treaty making power; the methods and traditional principles of the foreign policy of the United States; historical review of the principal diplomatic controversies between the United States and foreign powers from the foundation of the government to the present time; the rise of the United States to the position of a world power. *Twice a week; second semester.* Dr. MATHEWS.

8. COLONIAL ADMINISTRATION.—A study of the principal systems of colonial administration, notably those of Great Britain, France, The Netherlands and the United States, including a historical sur-

vey of the policy of the countries in dealing with their more important dependencies. *Twice a week; first semester.* Dr. Dodd.

[Not given in 1911-12].

10. Administrative Law in the United States.—Separation of governmental powers and delegation of legislative power; federal and state administrative organs; methods of enforcing governmental commands; remedies of the individual against unlawful action by public officers. *Three times a week; second semester.* Dr. Dodd.

[Not given in 1911-12].

11. Constitutional Aspects of Social and Industrial Problems.—The police power for the protection of the public safety, health and welfare; constitutional limitations upon legislation concerning the public health and safety; the control of public service corporations and combinations of capital and labor. *Three times a week; second semester.* Dr. Dodd.

12. National Administration in the United States.—A study of the President and Congress; the executive departments and the administrative services of the national government, including a survey of judicial administration and the relation of the courts to the administrative authorities. *Three times a week; second semester.* Associate Professor Fairlie.

[Not given in 1911-12].

13. State Administration in the United States.—A study of the state executive and administrative organization; organization of judicial and executive control over the administration. *Twice a week; second semester.* Dr. Mathews.

14. Political Parties.—A study of the development of political parties and their organization and influence on the government mainly in Great Britain and the United States, with attention to recent legislation in primaries and nomination methods in this country. *Twice a week, first semester.* Associate Professor Fairlie.

Political Philosophy.—See Philosophy 5. *Twice a week; second semester.* Professor Daniels.

[Not given in 1911-12].

SOCIOLOGY

Preparation for graduate work in sociology should include

the principles of economics and psychology, together with history. Unless the undergraduate preparation has also included the subject matter treated in one or more of the courses numbered 1, 2, 3 and 4, none of those courses may be omitted by a graduate student whose major subject is sociology.

Courses for Graduates

101. Sociological Method.—The method of advancing the science of sociology; adaptability to sociological investigation of certain methods described in Pierson's Grammar of Science, Wundt's Methodenlehre zweite abschnit, Seignobos' La Methode Historique Appliquée aux Sciences Sociales, and Bernheim's Historische Methode. *Three times a week; first semester.* Professor Hayes.

[Not given in 1911-12].

102. The Development of Sociology.—A reading course in the original works of the writers who have contributed most to the development of sociology. *Twice a week; both semesters.*

Professor Hayes.

150. Seminary.—Special topics for research. *One session of two hours once in two weeks; both semesters.*

Professor Hayes and Dr. Todd.

Courses for Graduates and Advanced Undergraduates

1. General Sociology.—Essential points of view involved in the application of scientific method to social interpretation, and certain fundamental concepts and main teachings of sociology. *Three times a week; first semester.* Professor Hayes.

2. Social Control and Sociological Ethics.—An explanation of the methods by which society controls the conduct, beliefs, and desires of its members, by law, religion, education, public opinion, and other agencies; together with a study of the rational motives of conduct. *Twice a week; second semester.*

Professor Hayes.

[Not given in 1911-12].

3. Comparative and Genetic Sociology.—A course for students who desire acquaintance with the comparative or "ethnol-

ogical" method of dealing with questions of theory in the social sciences; presenting a body of facts concerning social activities (economic, political, legal, ethical, religious, domestic, etc.) as they prevail or have prevailed among people at different stages of progress, savage, barbarous and civilized, with inductions from such facts including a theory of social evolution, and of the method of progress. *Twice a week; first semester.*

Professor HAYES.

4. PSYCHOLOGICAL SOCIOLOGY.—The conditioning of social activities by each other; public opinion, public sentiment, leadership, mobs, fashions, custom, conventionality, periods of social productivity and decay, etc. *Three times a week; second semester.*

Professor HAYES.

[Not given in 1911-12].

6. THE SOCIAL PROBLEMS OF THE URBAN COMMUNITY.—*Three times a week; second semester.* Professor HAYES.

7. SOCIAL PROBLEMS OF THE RURAL COMMUNITY.—*Three times a week; second semester.* Professor HAYES.

9. CRIMINOLOGY.—The criminal and the treatment of crime. *Three times a week; second semester.* Dr. TODD.

10. POPULATION.—Race traits and their influence on prevalent activities, immigration, the Negro in America, selective influences affecting the reproduction of population in the United States, public health as affected by occupation and other conditions. *Three times a week; first semester.* Dr. TODD.

26. EDUCATION IN RELATION TO SOCIAL ORGANIZATION AND PROGRESS.—*Three times a week; second semester.* Dr. TODD.

THE LABOR PROBLEM.—See Economics 12. This course will be counted for credit in Sociology, if desired, for students who take that subject as a major.

SOCIALISM AND SOCIAL REFORM.—See Economics 21. This course will be counted for credit in sociology, if desired, for students who take that subject as a major.

C. Education, Philosophy and Psychology

EDUCATION.

Graduate students who elect education as a major subject must have completed the following undergraduate courses or their equivalents: Education 1 and 2, and at least three hours in psychology and three hours in philosophy. In the case of graduate students who have had exeprience in teaching, these requirements may be modified.

Courses for Graduates

101. SEMINARY.—*Both semesters.*

Professor BAGLEY, Assistant Professor ANDERSON.

111. PRACTICE-TEACHING.—Students who desire to enroll in this course must present, from the head of the University department representing the subject that they propose to teach, satisfactory evidence that they are qualified from the standpoint of subject-matter. Each graduate student who takes this course must select, with the approval of the department of Education, some problem of teaching or management upon which there is a division of opinion among educators, plan means for investigating this problem, and present a written report of his methods and results before the close of the term. *Five times a week; first and second semesters.*

Professor BAGLEY.

[Not given in 1911-12]

Courses for Graduates and Advanced Undergraduates

4. CONTEMPORARY EDUCATIONAL CONDITIONS AND MOVEMENTS IN THE UNITED STATES.—The interpretation of present tendencies as exemplified in the school systems of typical cities and states and in recent educational experiments in administration, discipline, methods, and subject matter. *Twice a week; first semester.* Dr. ———

[Not given in 1911-12].

5. COMPARATIVE STUDY OF THE SECONDARY SCHOOLS OF FRANCE, GERMANY, ENGLAND, AND THE UNITED STATES.—The different types of secondary schools in each country; conditions of their origin

and development; their present status and relation to elementary schools and universities. *Twice a week; second semester.*

Professor BAGLEY.

6. PRINCIPLES OF SECONDARY EDUCATION.—High school organization and management. A discussion of the essential elements of a high school, together with a consideration of the conditions existing in Illinois. Especial attention is given to the educational values of the studies represented in the secondary curriculum, to the structure of the course of study, and to the technique of secondary teaching and management. *Three times a week; second semester.* Professor BAGLEY, Assistant Professor HOLLISTER and special lecturers.

7. HISTORY OF INDUSTRIAL AND VOCATIONAL EDUCATION.—Industry and industrial training in Egypt, Greece, Rome; industry and industrial training in the Middle Ages; the industrial revolution and its effect upon education; recent tendencies in the development of agricultural and industrial high schools, agricultural colleges, monotechnic schools, continuation schools, etc. *Twice a week; second semester.* Assistant Professor ANDERSON.

13. EDUCATIONAL CLASSICS.—A critical study of the sources of the history of education. The more important educational works of Plato, Aristotle, Quintilian, Montaigne, Milton, Locke, Rousseau, Pestalozzi, Herbart, Froebel, Spencer, and others are considered. *Three times a week; first semester.* Assistant Professor ANDERSON.

17. HERBART AND FROEBEL.—The philosophy, psychology, and pedagogy of Herbart and Froebel are critically studied and compared with other pedagogical systems. *Twice a week; first semester.* Assistant Professor ANDERSON.

18. PRINCIPLES OF ESTHETIC, MORAL AND RELIGIOUS EDUCATION.—Values, ideals, and methods of each; their relation to each other, to intellectual training, and to the utilities of life; their effects on social and national life and on the general advancement of the fine arts; selection of the material of instruction, and the development of individual taste and conscience; the public school, the Sunday school, and other instrumentalities. *Three times a week; first semester.*

[Not given in 1911-12].

20. Philosophy of Education.—*Three times a week; first semester.*

20a. Theory of Supervision.—A study of the problems of supervision with especial reference to the training and improvement of teachers. Open only to graduate students, to seniors who are either graduates of normal schools or experienced teachers, and to seniors who are preparing for the work of supervision in special subjects, such as household science, manual training, and physical training. *Second semester.* Professor Bagley.

PHILOSOPHY

Students entering upon graduate work in philosophy should have had at least one course in the history of the subject, and one in psychology.

Courses for Graduates

101. The Philosophy of Plato and Aristotle.—*Twice a week; both semesters.* Professor Daniels.

102. Seminary.—Contemporary Philosophy. A study of present day idealism, realism, and pragmatism. *Twice a week; both semesters.* Professor Bode.

103. Seminary.—Ethical theory. *Once a week; both semesters.* Professor Daniels.

104. The Philosophy of Descartes, Spinoza and Leibniz.—*Twice a week; first semester.* Profesor Daniels.

[Not given in 1911-1912.]

105. The Philosophy of Schopenhauer and Lotze.—*Twice a week; second semester.* Professor Daniels.

[Not given in 1911-1912.]

Courses for Graduates and Advanced Undergraduates

5. Political Philosophy.—Philosophical theories of the state, historical, critical and constructive. *Twice a week; first semester.* Professor Daniels.

[Not given in 1911-1912.]

7. Ethics.—The beginnings and growth of morality; analysis and criticism of the leading conceptions of moral theory; discussion of some of the typical social and economic problems of the prseent. *Three times a week; second semester.* Professor Daniels.

11. Philosophy of Religion.—The philosophical interpretations of religious consciousness and a critical study of various religious concepts; God, revelation, inspiration, dogma, faith, prayer, immortality, the problem of evil, the relation of morality and religion. *Twice a week; second semester.* Professor Daniels.

[Not given in 1911-1912.]

15. The British Philosophers of the Eighteenth Century.—Locke, Berkeley and Hume. *Three times a week; first semester.* Professor Bode.

16. Kant.—The Critique of Pure Reason. *Three times a week; first semester.* Professor Bode.

PSYCHOLOGY

No student may do graduate work in psychology without having had courses 1 and 2, (elementary psychology), or their equivalent, and at least one three-hour course in philosophy.

Courses for Graduates

101. Research.—Opportunity to investigate advanced problems in experimental psychology, and in comparative and genetic psychology is offered to properly qualified graduate students. *Both semesters.*

102. Contemporary Literature.—The most imporant problems of contemporary psychology, with their historical bearings, will be presented and discussed. *Once a week; both semesters.* Assistant Professor Arps.

111. The Psychology of the Intellectual Processes.—*Twice a week; second semester.*

[Not given in 1911-12.]

113. Abnormal Psychology.—The pathological aspects of consciousness; arrested mental development in children and mental disorders in later life. *Twice a week; second semester.* Dr. Sutherland.

114. The Psychology of Memory.—Two lectures a week and two hours of laboratory demonstration. *Three times a week; first semester.* Assistant Professor Arps.

Courses for Graduates and Advanced Undergraduates

3. Experimental Psychology.—The object of this course is to train the student in laboratory methods, and to give him an intimate acquaintance with normal phenomena. *Twice a week; first semester.* Dr. Sutherland.

4. Experimental Psychology.—This course is a continuation of Course 3 and cannot be elected separately. *Twice a week; second semester.* Dr. Sutherland.

5. Genetic Psychology.—This course traces the mental development of the child from birth to maturity. The latter part is devoted to the phenomena of adolescence, and the intellectual problems confronting the body are traced in connection with the mental development. *Twice a week; second semester.*

Professor Colvin.

[Not given in 1911-12.]

6. Comparative Psychology.—This course aims at an analysis of animal behavior and its interpretation. *Twice a week; first semester.* Assistant Professor Arps.

9. Physiological Psychology.—This course deals with the physiology and psychology of the central nervous system and of the sense organs. Lecures and laboratory periods. *Twice a week; first semester.* Dr. Sutherland.

11. Educational Psychology.—The fundamental characteristics of the learning process considered from the biological standpoint; imagination, memory and association, attention and the higher rational processes analyzed. *Three times a week; second semester.*

Professor Bagley.

12. Minor Problems in Experimental Psychology.—This is an advanced laboratory course in which special investigations are undertaken by advanced undergraduate students. *Two to five times a week; both semesters.*

Assistant Professor Arps, Dr. Sutherland.

D. The Physical Sciences, Including Mathematics

ASTRONOMY

Course for Graduates

101. SEMINARY.—The work offered to graduate students is largely governed by the preparation and abilities of different individuals. *Three times a week; both semesters.*

Assistant Professor STEBBINS.

Courses for Graduates and Advanced Undergraduates

7. THEORETICAL ASTRONOMY.—This course begins with the elementary theory of the motions of the heavenly bodies, and is intended to lead the student up to the actual computation of a cometary orbit. *Three times a week; both semesters.* Dr. REED.

9. CELESTIAL MECHANICS.—A continuation of course 7. Introduction to the theory of disturbed planetary motion. *Three times a week; both semesters.* Dr. REED.

14. OBSERVATIONAL ASTRONOMY.—This course is intended for those who wish to become familiar with the working methods of an astronomical observatory. The problems set for solution are largely individual. *Three times a week; second semester.*

Assistant Professor STEBBINS.

15. GEODETIC ASTRONOMY.—Advanced work with the sextant, transit, and zenith telescope. *Three times a week; first semester.*

Assistant Professor STEBBINS.

CHEMISTRY

Graduate students whose major subject is in some other department than chemistry, before taking graduate work for credit in this department must have had the equivalent of 15 University hours in chemistry, and the ground covered must have included satisfactory work in general chemistry and in qualitative and quantita-

tive analysis. Such students are advised to take Chemistry 31, 33, 102, 102a, 5b, 5c, 14, and 9a and b. Courses of a more special nature will not, as a rule, be accepted for graduate work unless preceded by one of the above courses.

For students in agriculture 5a, and 13b will not be accepted for graduate credit.

Graduate students who are candidates for an advanced degree in chemistry must have had the equivalent of 30 University hours in chemistry, and this must include satisfactory courses in general chemistry, qualitative and quantitative analysis, physical chemistry, and organic chemistry. Before receiving the degree of Doctor of Philosophy such students are expected to complete work equivalent to courses 31, 33 (or 102 and 102a), 14, 9a, 9b, 101 and 111. They are advised to take at least brief courses in gas analysis, iron and steel analysis, water analysis, assaying, and chemical technology.

For students in chemistry 5a, 13a, 9 and 9c will not be accepted for graduate credit and 9a, 9b, 14, 31 and 33 will be accepted only from students entering the Graduate School with the equivalent of 30 University hours in chemistry.

Courses for Graduates

101. History and Theories of Chemistry.—A discussion of the historical development of the science of chemistry. *Twice a week; first semester.* Dr. Smith.

102. Advanced Physical Chemistry.—This course consists of lectures and seminar meetings and, together with 102a, is intended to cover a period of two years. The subject is treated from the standpoint of *Avogadro's Principle and Thermodynamics* and the course is based largely upon *Nernst's Theoretische Chemie.* The primary purpose of this course is to develop power to handle successfully a physico-chemical problem rather than to merely impart a knowledge of the phenomena and the principles involved. *Nernst's Theoretische Chemie, 6th edition. Twice a week; both semesters.* Assistant Professor Washburn.

[Not given in 1911-12.]

102a. Advanced Physical Chemistry.—A continuation of

course 102. This course alternates with course 102. *Nernst's Theoretische Chemie. Twice a week; both semesters.*

Assistant Professor WASHBURN.

102b. ADVANCED ELECTROCHEMISTRY.—This course deals with the modern theories of solution and the principles of thermodynamics in their application to the problems of electro-chemistry. The subjects of electrolytic conductivity and transference, electromotive force, and the energy principles underlying the transformations of chemical and electrical energy are discussed in detail. The recent advances in the electrolysis of fused electrolytes and the applications of electricity to gaseous reactions at high temperatures will be dealt with. *LeBlanc's Electrochemistry. Three times a week; second semester.* Dr. JONES.

102c. ADVANCED PHYSICAL AND ELECTROCHEMISTRY.—A laboratory course dealing with the applications of physicochemical methods to special problems. The nature of the experiments performed by the student will depend upon his previous training in this subject and his purpose in taking the course. The experiments are designed to develop the power of independent thinking in applying physico-chemical methods to problems in the laboratory. This course must be preceded or accompanied by courses 102, 102a or 102b. *Twice a week; first semester.*

Assistant Professor WASHBURN, Dr. JONES.

102e. SPECIAL TOPICS IN PHYSICAL CHEMISTRY.—A detailed study of certain branches of physical chemistry and its applications will be taken up in this course. The course will be conducted on the seminar plan and the topics considered will vary from year to year. Subject for 1910-11:—Capillary Chemistry and the Chemistry of Colloids. Subject for 1911-12:—Colloid Chemistry and the Ultramicroscope. This will include some laboratory work with the ultramicroscope. Instruments of both the ordinary and the cardioid types are available for the work of this course. *Freundlich's Kapillarchemie, Ostwald's Grundriss der Kolloidchemie. Once a week; first semester.*

Assistant Professor WASHBURN.

103. ADVANCED INORGANIC CHEMISTRY.—A systematic presentation of descriptive inorganic chemistry, including the rarer elements and based on the periodic system. The work consists of

two lectures a week throughout the year, which may or may not be accompanied by laboratory work on advanced inorganic preparations. *Two to five times a week; both semesters.*

Assistant Professor BALKE.

103a. ADVANCED ANALYTICAL CHEMISTRY.—The lectures will deal with special topics in analytical chemistry, and may or may not be accompanied by laboratory work. *One to five times a week; second semester.* Dr. BURGESS.

103b. SPECIAL TOPICS IN INORGANIC CHEMISTRY.—A detailed study of certain branches of inorganic chemistry will be taken up in this course. The course will be conducted on the seminar plan and the topics considered may vary from year to year. Subject for 1911-12: The Theories and Investigations of Werner. *Werner's Neuere Anschauungen auf dem Gebiete der anorganischen Chemie. Once a week; both semesters.* Dr. SMITH.

104. ADVANCED ORGANIC CHEMISTRY.—Special chapters. This course consists of two lectures a week with assigned reading and is especially recommended to students doing research work in this subject. Special attention is given to the detailed study of recent research methods in such fields as: Condensation, carbohydrates, fermentation, and enzyme action, the purine group, the proteins, isomeric change, stereochemistry of nitrogen, the relation of color to chemical constitution, alkaloids, etc. The chapters may be varied from year to year. *Twice a week; first semester.*

Assistant Professor CURTISS.

105. ADVANCED PHYSIOLOGICAL CHEMISTRY.—Selected portions of physiological chemistry not covered by chemistry 15. Lectures; conferences; demonstrations; assigned reading. *Three times a week; second semester.* Professor HAWK.

105a. ADVANCED PHYSIOLOGICAL CHEMISTRY.—Special topics. Laboratory. *Two to five times a week; second semester.*

Professor HAWK, Dr. HOWE.

106. ANIMAL CHEMISTRY.—A lecture course consisting of a critical study of the recent advances in the chemistry of nutrition of the lower animals, and a detailed study of the chemistry of the functional products, such as flesh, fat, milk, wool, etc. of the more common domesticated animals. *Twice a week; both semesters.*

Professor GRINDLEY.

107. Calorimetry of Fuels.—An advanced course in the study of methods for determining the heat values of solid, liquid, and gaseous fuels. *One to three times a week; both semesters.*

Professor Parr.

107a. Composition and Classification of Coal.—A lecture and reading course on the composition of coal with reference to its classification, changes in composition, weathering, spontaneous combustion, formation of mine gases, etc. *Once a week; second semester.* Professor Parr.

108. Metallography.—Lectures, reading and laboratory work on the constitution and microstructure of metals and alloys and on the relations between their properties, chemical, and mechanical treatment and structure. *Twice a week; second semester.*

Assistant Professor McFarland.

110. Water Supplies.—A study of the sources of contamination of water supplies and the purification of water for potable or technical use. *Five times a week; both semesters.*

Professor Bartow.

111. Thesis Work.—A thesis is usually required of students taking the Master's degree and is always required of students taking the degree of Doctor of Philosophy.

Physical and Electrochemistry.—Assistant Professor Washburn, Dr. Jones.

Inorganic Chemistry.—Assistant Professor Balke, Dr. Smith.

Analytical Chemistry.—Dr. Burgess.

Food Chemistry.—Dr. Beal.

Organic Chemistry.—Professor Noyes, Assistant Professor Curtiss, Dr. Derick.

Water Analysis and Sanitary Chemistry.—Professor Bartow.

Physiological Chemistry.—Professor Hawk.

Animal Chemistry.—Professor Grindley.

Industrial Chemistry.—Professor Parr, Assistant Professor McFarland.

Courses for Graduates and Advanced Undergraduates

5c. Food Analysis.—This course includes the analysis of food

stuffs, grain, milled products, alcholic beverages, baking powders, vinegars, syrups, sugars, etc. Students who have taken work amounting to five hours' credit in this course may arrange to do more advanced work along the following lines: (a) the study of methods for detecting food adulteration; (b) the separation and determination of the nitrogenous constituents of animal and vegetable foods; (c) the identification and estimation of carbohydrate constitutents of food products. *Three to five times a week; second semester.* Dr. BEAL.

6*. CHEMICAL TECHNOLOGY.—This is a course of lectures comprising a study of technological chemistry as illustrated in those industries having a chemical basis for their principal operations and processes. Much use is made of the journals. *Thorp's Industrial Chemistry* is used as a guide. No laboratory work. *Twice a week; second semester.* Professor PARR.

7*. METALLURGY.—A general course in metallurgical processes. Lectures and assigned reading. *Three times a week; first semester.* Professor PARR.

8. IRON AND STEEL ANALYSIS.—Analyses are made of all the constituents by both rapid or technical, and standard methods. *Three times a week; second semester.* Dr. BURGESS.

9a. ORGANIC SYNTHESIS.—Laboratory work for students of the chemical course, in ultimate organic analysis and the preparation and study of typical organic compounds, to accompany Chemistry 14. *Twice a week; first semester.* Assistant Professor CURTISS, Dr. DERICK.

9b. ORGANIC SYNTHESIS AND ANALYSIS.—Continuation of 9a, to accompany Chemistry 14. *Twice a week; second semester.* Assistant Professor CURTISS, Dr. DERICK.

10a. WATER ANALYSIS.—Lectures on history, sources, contamination, and standards of purity of potable waters and waters for industrial purposes, together with practice in analytical methods. *Three times a week; second semester.* Professor BARTOW.

13b. ADVANCED AGRICULTURAL ANALYSIS.—This course is offered to students who wish to specialize in agricultural chemistry

*Certain inspection trips will be arranged in connection with courses 6 and 7. Students registering in these courses should take into consideration the expense involved, which will approximate $15.00 for each course.

or agricultural experimentation. The work includes the analysis of butter and cheese, the complete analysis of foods, soils, and plants, plant ash, rain and drain waters, and the determination of the fuel value of foods. If desirable, the work may be varied to meet the special needs of the individual student. *Three to five times a week; second semester.* Dr. BEAL.

14. ORGANIC CHEMISTRY.—This course consists of lectures and recitations upon the fundamental principles and more important compounds of organic chemistry. *Noyes's Organic Chemistry.* This course must be accompanied by Chemistry 9a and 9b. *Three times a week; both semesters.* Professor NOYES.

15. PHYSIOLOGICAL CHEMISTRY.—This course is designed especially for students desiring a knowledge of the fundamental principles of physiological chemistry. It consists of lectures, demonstrations, conferences and practical work. The course includes a systematic study of enzymes, carbohydrates, salivary digestion, gastric digestion, fats, pancreatic digestion, intestinal digestion, bile, putrefaction products, feces, blood, milk, epithelial and connective tissue, muscular tissue, nervous tissue, urine. The work on gastric juice, blood, urine, and milk is both qualitative and quantitative, and all the clinical aspects of these topics are treated thoroughly for the prospective students of medicine. The course is open to graduates and undergraduates. *Hammersten's Text Book of Physiological Chemistry; Hawk's Practical Physiological Chemistry. Five times a week; first semester.* Professor HAWK, Dr. HOWE.

15a. METABOLISM AND NUTRITION.—Metabolism; activities of gastro-intestinal tract; enzymes; inorganic nutrition, etc. Lectures; demonstrations; conferences. *Twice a week; second semester.* Professor HAWK.

21. PROXIMATE ORGANIC ANALYSIS.—A course of laboratory practice for advanced students in systematic methods for the identification of organic compounds, and a study of organic mixtures as found in commercial articles. *Twice a week; first semester.* Dr. DERICK.

22. ANIMAL CHEMISTRY.—A course for the detailed study of the chemical composition of animal products and feeding stuffs. This is a combined classroom and laboratory course. *Three to five times a week; first or second semester.* Professor GRINDLEY.

27. Qualitative Analysis of the Rare Elements.—A detailed study of rare elements and their compounds. The work consists mainly in the identification and separation of the elements and the study of formation, solubilities, and chemical reactions of their salts. Reading is assigned in connection with laboratory work. *Three times a week; second semester.*

Assistant Professor Balke.

31. Elementary Physical Chemistry.—This course is designed to present, in an elementary manner, some of the more important principles and methods of physical chemistry and electrochemistry. Instruction is given by lectures and recitations. To secure familiarity in applying the laws and principles of physical chemistry to practical problems in other branches of chemistry, the student is expected to solve numerous problems in connection with this course. *Walker's Introduction to Physical Chemistry. Three times a week; second semester.* Assistant Professor Washburn.

33. Elementary Physical Chemistry.—A laboratory course to accompany course 31. The experiments performed include the methods of determining molecular weight both in the gaseous state and in solution; the application of the principles relating to chemical equilibrium; the measurement of the electrical conductivity of solutions and the application of this property in interpreting the phenomena occuring withing the solution; and the illustration of some of the fundamental conceptions of thermochemistry. *Twice a week; second semester.* Dr. Jones, Dr. MacInnes.

35. Electrochemistry.—Recitations or lectures and laboratory work dealing with the practical applications of electrochemistry in the industries; intended for students going into technical work. The study of patents is made an important feature of the course, each student being required to collect, study and report upon the more important patents in some selected industry. *Thompson's Applied Electrochemistry.* See also Chemistry 102b. *Three to five times a week; first semester.* Dr. Jones.

61. Inorganic Preparations.—A laboratory course in the preparation of chemical products from raw materials. The manufacture and testing of pure chemicals, fractionation, and other processes of the manufacturing chemist. *Twice a week; second semester.* Dr. Jesse.

65. Technical Gas and Fuel Analysis.—Examination of gases, gas fixtures, flue gases, and fuels. Determination of calorific values and calculation of efficiencies. *Twice a week; first semester.* Professor Parr, Dr. Jesse.

66. Technology of Gases.—Lectures, reading, and reports on the manufacture, constituents, and uses of the various forms of gaseous fuel. The laboratory work will include calorimetry, photometry, and some of the more usual methods of analysis. *Once a week; second semester.* Dr. Jesse.

68a. Analysis of Glasses and Glazes.—For students in ceramics. A study of methods and practice on special problems connected with the pottery industry. *Three times a week; first semester.* Dr. Burgess.

68b. Cement Chemistry.—For students in ceramic engineering. This course includes the analysis of cements, cement materials, pottery, bodies, etc. *Three times a week; first semester.* Dr. Burgess.

69. Assaying.—The fire assay of lead, gold, and silver ores, Fluxes, reagents, and charges are studied in connection with various typical ores, and practice given in use of the crucible and muffle furnaces and in the manipulations connected with fire assaying. *Twice a week; first semester.* Professor Parr, Dr. Jesse.

70. Advanced Assaying and Ore Testing.—A continuation of Chemistry 69, involving the assay of more complex ores; ores of platinum, tin, copper, bullion assay, free milling, amalgamation, and cyaniding tests. *Twice a week; second semester.* Assistant Professor McFarland.

71. Wet Methods of Assay.—Technical methods of copper, lead, zinc, antimony, arsenic, tin, etc. in ores and metallurgical products. Laboratory course. *Twice a week; first semester.* Assistant Professor McFarland

72. Paints, Oils, Turpentines, Varnishes, and Protective Coverings for Wood and Metals.—Lectures and laboratory. *Twice a week; first semester.* Professor Parr.

93. Journal Meeting.—For juniors, seniors, and graduates. *Once a week; both semesters.* All members of the teaching staff in the Chemical Department.

GEOLOGY

Courses for Graduates

101. Advanced Crystallography.—This course is intended to familiarize the student in chemistry or mineralogy with the methods used in measuring, projecting and calculating crystal forms, and determining the physical properties of crystallized bodies. It includes determination of indices of refraction, electrical properties, morphotropsim, etc. *Three to five times a week; first or second semester.* Associate Professor Bayley.

102. Petrography.—Lectures and laboratory work on the igneous rocks including identification of types, classification and relationships. *Two hours five times a week; first semester.*

Associate Professor Bayley.

103. Petrography.—A continuation of Course 102 in which schists and sedimentary rocks become the object of study. *Two hours, five times a week; second semester.*

Associate Professor Bayley.

105. Stratigraphic Paleontology.—A course devoted to the study of literature and the fossils of a special geological system; their geographic distribution; the geologic provinces; and the origin and the routes of migration of the different faunas during the period. Largely individual work. *Two to five times a week; first or second semester.* Assistant Professor Savage.

106. Field and Laboratory Course.—A course consisting of a systematic study of a selected area in Jackson and Union counties, Illinois. A carefully prepared report on the geology of the region, based on the data collected in the field, is required. *Two to five times a week; first or second semester.*

Assistant Professor Savage.

Courses for Graduates and Advanced Undergraduates

6. Physical and Optical Mineralogy.—A direct introduction to the courses in Petrography. The physical and optical properties of minerals are discussed in lectures and studied in the laboratory, with special reference to their relations with respect to symmetry. The larger portion of the work is devoted to

the study of polarized light and its practical use in identifying the rock-form materials. *Two hours, five times a week; second semester.* Associate Professor BAYLEY.

7. PETROGRAPHY.—The principles learned in Course 6 are applied to the study of rocks. Lectures describe the different types of these rocks and discuss their origin and classification. In the laboratory a representative suite of specimens is studied in the hand specimen and thin section. *Two hours, five times a week; first semester.* Associate Professor BAYLEY.

9. PALEONTOLOGY.—A study of invertebrate fossils, their classification and relationship, their succession in the rocks, and their geographic distribution. Instruction is given in the identification of the fossils, and in the finding and use of the literature of the subject. *Two hours, five times a week; first semester.* Assistant Professor SAVAGE.

16. STRATIGRAPHY.—This course follows course 9, and is a study of principles of classification and nomenclature of rock formations, of the methods and criteria employed in correlation, of the characteristic faunas and floras of the successive geologic formations and their distribution, and of the relation of these to the interpretation of stratigraphy. Lectures and laboratory. *Two hours, five times a week; second semester.* Assistant Professor SAVAGE.

17. STRATIGRAPHIC GEOLOGY.—A study of the distribution of the strata of the successive geological systems, the character of the sediments which compose them, and the interpretation of these deposits and their distribution in their relation to paleo-geography. *Five times a week; second semester.* Assistant Professor SAVAGE.

18. MESOZOIC AND TERTIARY PALEONTOLOGY.—A study of the classification and development of the mesozoic and tertiary invertebrate fossil forms, with some consideration of the evolution of vertebrates during the same period. This course is especially helpful to those who specialize in botany or zoology. *Five times a week; second semester.* Assistant Professor SAVAGE.

19. FIELD GEOLOGY.—Introductory Course.—A field course of two weeks will be taken as a course introductory to the study of Stratigraphy, Paleontology, and Physiography. *Twice a week; first semester.* Assistant Professor SAVAGE.

20. Field Geology.—A short field course in geology will be given during the summer of 1911 (June 16 to 30.) This will involve training in field, determination of physical features and rock formations, with mapping and description, of a small area in Carroll county, Illinois. *Twice a week; second semester.*

Assistant Professor Savage.

Ceramics

Courses for Graduates

The subject of silicates and the silicate industries offers a unique field for research, since there is probably no other field of technology which needs so much the plow and harrow of the investigator. The problems to be solved are practically unlimited in number, and some branches represent indeed a terra incognita.

Ceramics 101. The theoretical principles unlerlying the formation of silicates are considered from the modern standpoint, involving the conceptions of physical chemistry. Lectures and laboratory work. *Five times a week; first semester.*

Professor Bleininger.

Ceramics 102.—Special problems relating to the technology of the clay industries. Some of the topics which may be selected are: Mineralogical constitution of clays, plasticity and the collodial state, absorption, pyro-chemical and physical changes, exothermic and endothermic processes, the crystalline and amorphous state of burnt clay, thermal expansion of bodies and glazes, bodies and their interaction with glazes, the composition and constitution of glazes, dissolved underglaze colors, translucency and opacity, the colors of rare oxides in glazes, eutectic studies, reduction and oxidation phenomena, heat radiation and conduction. *Five times a week; both semesters.* Professor Bleininger.

Ceramics 103.—Special problems relating to the technology of the cement and mortar industries. Topics: Fusion curves of lime, lime-iron, lime-alumnia and lime-iron-alumnia silicates, the action of catalyzers, crystalization of basic silicates, constitution of cement compounds, hydration and dehydration, thermal studies, etc. *Five times a week; both semesters.* Professor Bleininger.

CERAMICS 104.—Problems relating to the technology of glass. Topics: Fusion curves of glass silicates, limiting compositions, solubility of the oxides in glasses, devitrification, annealing, optical properties, solubility of glasses, viscosity, thermal expansion, pyrochemical volume, change, etc. *Five times a week; both semesters.*

Professor BLEININGER.

MATHEMATICS

Library Facilities.—The mathematical library of approximately 2,000 volumes, selected with special reference to graduate instruction and research, is in a room set aside in the Natural History Building for the departmental library, to which all graduate students have easy access.

In addition to thirty five mathematical journals kept in the department seminar room, the general University library receives regularly about 1,600 periodicals, a considerable number of which are partly devoted to mathematics. We mention in particular the proceedings of various scientific societies such as, for example: Les Comptes Rendus de l'Académie des Sciences (Paris); Sitzungsberichte der k. Akademie (Berlin); Nachrichten der Gesellschaft der Wissenschaften zu Göttingen: Transactions of the Royal Society (London), etc., etc.

Models, Apparatus, Etc.—The department has in its possession a collection of models for instruction and research in analysis, geometry, and kinematics. This collection contains a large number of plaster of Paris casts from the famous collections of Schilling and Wiener, illustrating the properties of surfaces of the first four orders and of the differential properties of surfaces in general. A considerable number of string models are available for demonstrating the properties of ruled surfaces and space curves; other models of wire and celluloid serve to make clear the peculiarities of space curves, in particular those of the third order. Plaster models, some of which have been orginated and constructed by students under the guidance of instructors, illustrate important points in the theory of functions. The collection also contains a number of kinematic models illustrating the generation of trochoids of various kinds, inversors, etc.

The department possesses a collection of computing machines, slide rules of various kinds, planimeters, integraphs, a harmonic analyser, etc.

Previous Training.—It is advisable that students entering upon graduate study in mathematics should have had a course in calculus extending through the year and a course in the theory of equations.

Courses for Graduates

101. Functions of Real Variables.—An introduction to the theory of functions of real variables, making use of the general principles of the theory of assemblages. *Three times a week; both semesters.* Professor Townsend.

102. Fourier's Series.—This course is intended for students both of pure mathematics and of the physical sciences. It consists of brief consideration of the elementary theory of Fourier's and allied series, followed by detailed discussion of numerous physical applications and consideration of classical and recent researches concerning the properties of Fourier's series and operations upon them. *Three times a week; both semesters.* Dr. Crathorne.

103. Theory of Potential.—The elements of the theory of the logarithmic and Newtonian potential functions. Green's theorems and functions. Boundary value problems. Applications to physical problems. *Three times a week; both semesters.* Dr. Crathorne.

110. Elliptic Functions.—The elements of the theory of elliptic functions with applications to geometry and mechanics. Introduction to the theory of the elliptic modular functions. *Three times a week; both semesters.* Assistant Professor ————

111. Automorphic Functions.—An introduction to the theory of automorphic functions. The first semester will be devoted mostly to the group-theoretic side of the theory; the second semester will be concerned with the function-theoretic developments and applications. *Three times a week; both semesters.*

[Not given in 1911-12.]

113. Theory of Linear Differential Equations.—*Three times a week; both semesters.* Dr. Crathorne.

120. Elementary Theory of Groups.—The study of the groups which present themselves in arithmetic, geometry, and trigonometry is followed by a determination and study of those which can be represented with a small number of letters. The latter part of the course is devoted to abstract group theory and the Galois theory of equations. *Three times a week; both semesters.*

Professor Miller.

121. Theory of Groups.—Second course. This course presupposes about one year's work in group-theory. It is devoted to special topics depending upon the needs of the class. The early part of the course is given to the consideration of recent advances and methods along these special lines, and the latter part to research. *Three times a week; both semesters.* Professor Miller.

[Not given in 1911-12.]

124. Theory of Numbers.—The principal subjects considered in this course are: congruences, Kronecker's modular systems, quadratic residues, quadratic forms, and algebraic numbers. *Three times a week; both semesters.* Professor Miller.

[Not given in 1911-12.]

129. Theory of Statistics.—The general methods of statistical investigation, the application of the theory of probability to statistical data, the fitting of curves to observation, interpolation, theory of errors, and the mathematical theory of variability and correlation, the application of the principles developed to problems in economics and biology. *Three times a week; both semesters.*

Assistant Professor Rietz.

130. Invariants and Higher Plane Curves.—This course includes the general theory of algebraic curves, together with the application of the theory of invariants to higher plane curves. Special study is made of curves of the third and fourth order. *Three times a week; both semesters.* Assistant Professor Sisam.

131. Algebraic Surfaces.—In this course are considered the application of homogenous coördinates and the theory of invariants to geometry of three dimensions, and also the general theory of surfaces, together with the special properties of surfaces of the third and fourth order. *Three times a week; both semesters.*

Assistant Professor Sisam.

135. Metric Differential Geometry.—Applications of the cal-

culus to the general theory of curves and surfaces based primarily on the use of Cartesian coördinates. Relation of the theory of surfaces to the theory of invariants of a pair of quadratic differential forms. *Three times a week; both semesters.*

140. The Fundamental Concepts of Mathematics.—A course dealing with general concepts of higher mathematics in their bearing on elementary mathematics. *Three times a week; both semesters.* Dr. Lytle.

Courses for Graduates and Advanced Undergraduates

10. Introduction to Higher Algebra.—This course aims to introduce the student to a few subjects in higher algebra, including linear dependence, theory of matrices, complex numbers and the fundamental theorem of algebra. It begins with a study of a few fundamental properties of polynomals and determinants, presupposing at least two years' training in college mathematics, including a course in the calculus. *Three times a week; first semester.* Professor Miller.

11. Synoptic Course in Mathematics.—This course is intended to give a general survey over a considerable portion of modern mathematics. The treatment is largely historical, and attempts to demonstrate the importance of mathematics in the intellectual history of the race. The principles which underlie the most important divisions of mathematical science, pure and applied, are discussed, but no attempt is made to develop in the student that technical skill and intimate knowledge of detail which is necessary for the specialist. *Twice a week; both semesters.*

16. Differential Equations.—This course embraces the following topics: General linear equations with constant coefficients, special forms of differential equations of higher order, integration in series, etc. *Three times a week; first semester.* Professor Shattuck.

17a. Advanced Calculus.—This course begins with the consideration of the fundamental notions and theorems of the calculus from a more advanced and critical point of view. This is followed by the study of certain more advanced topics in the integral

calculus, including elliptic intregals and functions defined by definite intregals. *Three times a week; second semester.*

Dr. CRATHORNE.

19a. SOLID ANALYTICAL GEOMETRY.—A general review of the equations of the plane and the right line in space and the more general properties of surfaces of the second degree. The classification and special properties of quadratics, and a brief introduction to the theory of surfaces in general. *Three times a week; second semester.* Assistant Professor SISAM.

20. CALCULUS OF VARIATIONS.—This course has for its aim merely to acquaint the student with those elements of the science which are most needed in the study of the higher subjects of mathematical astronomy and physics. *Three times a week; second semester.* Professor SHATTUCK.

21a. METHOD OF LEAST SQUARES.—The fundamental principles of the subject. The following topics are studied: Law of probability and error, adjustment of observations, precision of observations, independent and conditional observations, etc. *Twice a week; first semester.* Assistant Professor STEBBINS.

22a. PARTIAL DIFFERENTIAL EQUATIONS.—This course deals with the integration and determination of the integration constants of such partial differential equations as arise in the study of such subjects as the flow of heat, the vibration of strings, plates, etc., and electricity. *Twice a week; second semester.* Dr. WAHLIN.

23a. AVERAGES AND THE MATHEMATICS OF INVESTMENT.—The meaning, use, and abuse of different kinds of averages. The relation of the theory of probability to annuities, insurance, and various branches of science. Such information relating to loans and investments as can best be put into algebraic language, and are of interest to the general student. Many practical problems are given in the evaluation of investment securities. *Three times a week; second semester.* Assistant Professor RIETZ.

24a. FUNCTIONS OF A COMPLEX VARIABLE.—A general introduction to the theory of functions of a complex variable. *Three times a week; both semesters.* Professor TOWNSEND.

27. PROJECTIVE GEOMETRY AND LINEAR TRANSFORMATIONS.—Sets of postulates for general projective geometry and the introduction of analytic methods on the basis of these assumptions. Pro-

jective transformations in the line, plane, and space. Introduction to the algebra of matrices and the theory of invariants. Subgroups of the general projective group. Euclidean, non-euclidean, and affine geometries. Theory of conics and quadric surfaces. Real and complex geometries. Throughout the emphasis is on geometric and algebraic inter-relations. *Three times a week; both semesters.*

Dr. Börger.

30. Seminary and Thesis.—*Three times a week; both semesters.* Professors Townsend, Miller, Assistant Professors Rietz, Shaw.

31. Actuarial Theory.—The application of probability to life contingencies, the construction and graduation of mortality tables, the elements of fire insurance and the calculations of premiums for various types of insurance. *Three times a week; first semester.*

Assistant Professor Rietz.

PHYSICS

The prerequisite for graduate work in physics is a college course in general physics with a year's laboratory course in introductory physical measurements. The student who is to do major work in physics should also have had additional courses in physics or teaching experience, unless the training in his minor subjects, mathematics or chemistry, has been strong and complete. He should also have a knowledge of French and German sufficient to use references in these languages. The courses named below are those open for candidates for the Master's or Doctor's degree. A large part of the last year's work of the candidate for the Doctor's degree is investigational, along either the experimental or the theoretical side of physics. In addition to these major graduate courses, the courses in elementary dynamics, heat, light, electrical measurements, and introductory electrical theory, (courses 114, 125, 120, 104, 130), are arranged with certain additions for graduate credit. The "intermediate" courses on heat, light and electricity and magnetism, (courses 15, 16, 17), may be offered by students making a minor in physics.

Courses for Graduates

121. Recent Advances in Physical Science.—Lectures illustrated by experiments on the more recent developments of physics.
Assistant Professor Knipp.

[Not given in 1911-12.]

123. Sound.—Lectures and recitations, *Barton's Text-book on Sound* is used. *Twice a week; both semesters.*
Assistant Professor Watson.

[Not given in 1911-12.]

124. Conduction of Electricity through Gases and Radio-activity.—An experimental course, with systematic reading and discussions. *McClung's Conduction of Electricity through Gases and Radio-activity* is used as a text-book with systematic references to the classic text-books of J. J. Thomson and Rutherford, and also to the papers in the journals. *Three times a week; both semesters.*
Professor Carman.

126. Physics Club.—Weekly meeting of the instructors and advanced students of the department to discuss assigned papers and topics. These discussions are often accompanied by experimental demonstrations. *Once a week; both semesters.*

127. Electron Theory.—Lectures and discussions on cathode rays, the general properties of the electron, theory of Roentgen rays, optical properties of moving media, principle of relativity, and the new corpuscular theory of light. *Twice a week; both semesters.*
Assistant Professors Kunz.

131. Investigation of Special Problems.—An advanced course in laboratory or in design and calculation. A problem is chosen and worked out with the advice and direction of the instructor. *Three or five times a week; both semesters.*
Professor Carman, Assistant Professors Knipp, Watson, Schulz, Kunz.

132. Mathematical Physics.—Special topics in theoretical physics.

(a) Dynamics.—First part: dynamics of a material system; determination of the center of gravity; of moment of inertia and of potentials; second part: the principle of least action; Lagrange's equations; motions of the top and applications. *Three times a week; both semesters.*
Assistant Professor Kunz.

(b) Electrodynamics.—(1). The Principles of electrodynamics, Maxwell's functions, potential theory, and theorems of the vector analysis; theory of electro-magnetic waves. Lectures; collateral reading. *Four times a week; both semesters.*

(2) Various applications of Bessel's Functions to electric currents, etc. *Once a week; both semesters.* Assistant Professor KUNZ.

(c) Thermodynamics.—Fundamental principles with applications to physical and chemical phenomena. Lectures; recitations. *Three times a week; both semesters.*

Assistant Professor KUNZ.

133. SEMINARY.—*Three or five times a week; both semesters.*

Professor CARMAN, Assistant Professors KNIPP, WATSON, SCHULZ, KUNZ.

Courses for Graduates and Advanced Undergraduates

4. ELECTRICAL AND MAGNETIC MEASUREMENTS.—Laboratory exercises with discussions and recitations. The course extends throughout the year. It is taken by junior students in electrical engineering and is recommended to others wishing an exact course in electrical magnetic measurements. *Twice a week; both semesters.*

Assistant Professor KNIPP, Dr. WILLIAMS, Mr. SMITH.

14. MECHANICS AND ADVANCED GENERAL PHYSICS.—An introduction to theoretical physics involving the calculus. For the first semester, dynamics with a brief introduction to themodynamics. For the second semester, elementary mathematical theory of electricity and magnetism, with a brief introduction to theory of light. *Three times a week; both semesters.* Dr. TAYLOR.

20a. LIGHT.—Special phenomena; modern theories; readings in texts of Drude, Wood, and Preston. Lectures; recitations. *Twice a week; first or second semester.*

Assistant Professor SCHULZ.

20b. LIGHT.—Light measurements. Laboratory. *Two to five times a week; first or second semester.*

Assistant Professor SCHULZ.

21. RECENT ADVANCES IN PHYSICAL SCIENCE.—Lectures illustrated by experiments. *Once a week; second semester.*

Assistant Professor KNIPP.

23. Sound.—Lectures; recitations; experiments. *Twice a week; second semester.* Assistant Professor Watson.

25. Heat.—Measurements of temperature with thermo-couples, resistance thermometer, and optional pyrometers; melting and boiling points. Lectures; recitations. LeChatelier's High temperature Measurements. *Twice a week; second semester.*
Assistant Professor Watson.

29. Electrical Oscillations.—Oscillating currents of both low and higher frequencies with particular attention in the second semester to the theory of wave telegraphy and telephony. *Three times a week; both semesters.* Professor Carman.

30. Electricity and Magnetism.—Advanced electrical laboratory with accompanying theory. [Not given in 1911-12.]
Assistant Professor Knipp.

E. The Biological Sciences

BOTANY

The work outlined under "Courses for Graduates" is open only to those who have had liberal botanical training including at least one year of successful study in the general line in which it is desired further to specialize. These courses may be elected for minor or for major work.

Courses for Graduates

101. Cytology.—The influence of external agents on the cell. Special subjects for investigation are assigned upon consultation. Reports and discussions of current literature and research results. *Five times a week; both semesters.* Assistant Professor Hottes.

102. Physiology.—The effects of external stimuli on growth and movement. Special subjects for investigation are assigned upon consultation. Reports and discussions of current literature and research results. *Five times a week; both semesters.*
Assistant Professor Hottes.

103. Bacteriology.—Investigations upon morphologic and

physiological variation due to treatment; systematic studies upon the number, validity, and relationship of species, research upon special saprophytic or parasitic kinds of bacteria and upon methods of favoring or combating their activities. *Five times a week; both semesters.* Professor BURRILL.

104. BACTERIOLOGY.—Special methods, intended to develop technical skill introductory to research upon pathogenic bacteria. *Three times a week; second semester.*

105. BACTERIOLOGY.—Investigations upon micro-organisms related to the animal body in health and disease. *Five times a week; both semesters.*

106.—VEGETABLE PATHOLOGY.—Diseases of plants and disease agents. Special subjects are assigned upon consultation. *Five times a week; both semesters.* Professor BURRILL.

107. ECOLOGY AND PHYTOGEOGRAPHY.—Investigations upon plant associations and phytogeographic relations of selected areas, based on approved field work. Reports and discussions. *Two to five times a week; both semesters.*

Courses for Graduates and Advanced Undergraduates

After at least one year of approved botanical work and further prerequisites, on consultation, graduates may elect any of the courses 3, 5, 7, 8, 9, 10, 16, 18, and 19. or 20 for minor credit; and any of the courses 3, 7, 8, 9, or 18 and 19, with assigned additions, for major credit.

3. CYTOLOGY AND PHYSIOLOGY.—The first semester is devoted mainly to cytology and histology, with special attention to technique; the second, to a study of influences of external stimuli on growth and movement. *Five times a week; both semesters.* Assistant Professor HOTTES.

5. BACTERIOLOGY.—General principles of the science, methods of procedure, and a study of selected forms. Lectures, recitations, and laboratory work. *Five times a week; both semesters.* Professor BURRILL.

7. PLANT PATHOLOGY.—A study of the principal groups of parasitic fungi and plant diseases due to them, with methods of investigation and control. *Five times a week; both semesters.* Professor BURRILL.

8. Bacteriology.—A detailed study of selected species of bacteria or investigations upon assigned subjects. *Two to five times a week; both semesters.* Professor Burrill.

9. Cytology and Physiology, Advanced Course.—Special laboratory problems in certain phases of cytology and physiology. *Twice a week; both semesters.* Assistant Professor Hottes.

10. Seminary.—Reports and discussion upon assigned topics and results of research work. *Once a week; both semesters.* Professor Burrill.

16. Taxonomy of Special Groups.—Mostly laboratory and herbarium work, and assigned reading. *Five times a week; both semesters.*

18. Ecology.—Field and laboratory studies of selected areas, with assigned reading and lectures. The field work must be done wholly or in part during the preceding summer on an area approved by the instructor. *Two to five times a week; both semesters.*

19. Seminary in Ecology.—Reports and critical discussions of current literature and research work. For graduate credit must be taken with or after course 18. *Once a week; both semesters.*

20. Ecology and Taxonomy.—Special problems upon individual assignments, dealing mainly with the plants of Illinois and vicinity. *Two to five times a week; both semesters.*

ENTOMOLOGY

The prerequisite for graduate work in entomology is one year's work in biological courses, including an equivalent either of Zoology 10 or Entomology 1 or 4. Entrance upon major work in entomology requires the equivalent of entomology 2 and 3.

Courses for Graduates

103. Faunistic Entomology.—Problems in taxonomy, distribution, and ecology, accompanied by field work, conferences, and lectures. The department is especially favored in the work of this course by the fact that the collections and library of the State Entomologist and of the State Laboratory of Natural History are available for its use. *Five times a week; both semesters.* Professor Forbes, Assistant Professor Folsom.

108. Individual Research Courses.—Morphological, systematic, ecological, and economic entomology. *Arrange time; both semesters.* Professor Forbes, Assistant Professor Folsom.

Courses for Graduates and Advanced Undergraduates

2. General Entomology.—This course and entomology 3 form a year's connected major work in entomology, covering substantially the whole field. The present course is devoted mainly to field entomology in the fall and later to the morphological and physiological aspects of the subject. Beginning with the collection and preservation of specimens and the making of field observations, it is continued by laboratory studies of typical insects, made with special reference to the recognition of adaptive structures, and experimental work intended to determine their exact utilities. *Five times a week; first semester.* Assistant Professor Folsom.

3. General Entomology.—To be taken either with or without the preceding course. The classification and determination of insects, the study of life histories in the insectary and by field observation and the collection of information with respect to the ecological relations of insects, are the principal objects of this course. *Five times a week; second semester.*

Assistant Professor Folsom.

5. Advanced Entomology.—Under this head students desiring advanced work in entomology, especially as a preparation for thesis work in this subject, will be individually provided for on consultation with the entomological instructors. The course may be made to cover one or two semesters and to earn a three-hour or a five-hour credit in each. At least a three-hour course for one semester will be required as a preparation for entomological thesis work. *Three to five times a week; both semesters.*

Professor Forbes, Assistant Professor Folsom.

7. Systematic Entomology.—This course, while primarily entomological, is designed to be of general use to students of biology. The lectures include a historical and critical survey of the systems of classification; a discussion of the aims and methods of classification, the nature of species and genera, and other groups, and the rules of nomenclature; the preparation of taxonomic

articles, involving the study of bibliography, synonymy, analytical keys, etc. These subjects receive practical treatment in the laboratory, and to qualified students the unworked material of the State Laboratory of Natural History is available for study. *Three times a week; both semesters.* Assistant Professor Folsom.

8. Advanced Economic Entomology.—A course of lectures, recitations, and field and laboratory work intended to prepare students for service as economic entomologists in state and government positions. Agronomy 7 and Horticulture 1, 2, and 3 should also be taken as a part of this preparation. *Three times a week; both semesters.* Professor Forbes, Assistant Professor Folsom.

HOUSEHOLD SCIENCE

Students who wish to do graduate work in Household Science will find it to their advantage to specialize in either the scientific or the economic phases of the subject. In either case they should be able to offer an equivalent for twenty hours of household science given in the University of Illinois, with a minimum of one and one-half years of chemistry, a year of biological science, and a year of either economics or sociology.

Courses for Graduates

101. Home Economics.—A study of the origin and development of home economics, with particular reference to its industrial, educational, and sociological aspects. *First or second semester.* Professor Bevier.

102. Special Investigations.—Problems in the application of of the principles of bacteriology, chemistry, and physiology, to the ordinary processes used in preparation of food. *First or second semester.* Professor Bevier, Dr. Goldthwaite.

Courses for Graduates and Advanced Undergraduates

4. Food and Nutrition.—An application of the principles of pure science to the problems of food and nutrition. The problems may be physiological, chemical or bacteriological. *Five times a week; first semester.*

Professor Bevier, Assistant Professor Usher.

5. Dietetics.—The work in dietetics includes the following topics. The principles of diet, the relation of food to health; influence of age, sex, and occupation on diet; the construction of dietaries; dietetic treatment of certain diseases; principles of home nursing. *Three times a week; second semester.*

Assistant Professor Usher.

PHYSIOLOGY

Courses for Graduates

103. Research.—Every facility and encouragement, so far as the resources of the laboratory and library permit, are offered to those prepared to avail themselves of these, for research as part of the work for the Master's or the Doctor's degree, or for carrying on original work for publication. The research equipment of the laboratory is adequate for work in the subjects of histology, physiology and pathology.

111. Physiological Journal Club.—The club is composed of the teaching staff of the department, the graduate students, and such undergraduates as are sufficiently advanced to participate. Recent articles of interest in current journals are reported and discussed. This gives the student practice and confidence in presenting a condensed synopsis of a subject before a meeting. Each student reports a paper about once in two months. Time is arranged, as far as possible, to suit the convenience of members of the club.

Courses for Graduates and Advanced Undergraduates

1. Histology.—This course consists of a study of the fundamental mammalian tissues, and the microscopic anatomy of the organs. Lectures and laboratory. *Five times a week; first semester.*

2. Major Course.—This includes a study of the physiology of nerve and muscle, circulation, respiration, secretion, digestion, metabolism, etc. Lectures and laboratory work. *Five times a week; second semester.*

5. Special Physiology.—This course is given to meet an

emergency, which sometimes arises, where a student wishes to take up a special line of work not specified in one of the other courses, and not involving the preparation of a thesis. At the discretion of the head of the department students may register for such work. Arrange details with the instructor.

ZOOLOGY

The equipment of the department includes the usual apparatus, microscopes, microtomes, paraffin baths, demonstration material and reagents. The various special laboratories are being equipped with special apparatus and demonstration material in accordance with their particular needs. Provision is made for meeting such special demands as may arise in connection with individual work.

The University Museum contains valuable series of mounted vertebrates, of Ziegler embryological models, and of alcoholic material in all groups; these are available as needed for either teaching or research.

The extensive collections and library of the Illinois State Laboratory of Natural History are freely available to advanced students. They are unusually rich in that which pertains to fresh water biology. The private library and collections of the head of the department, which contains much material on invertebrate morphology and on parasitism, are also placed at the disposal of graduate students.

Two years of undergraduate work in zoology are ordinarily presupposed as a condition for entering upon graduate study in the department. When the work is chosen for a minor the courses listed for graduates and undergraduates, to be acceptable, must be preceded by at least one full year's undergraduate work in zoology. Work done at other institutions will be valued on conference with the head of the department.

Courses for Graduates

103. Histology of the Nervous System.—A comparative study of invertebrates and vertebrates with reference to their form, composition, and topographical relations. The evidence for and against the neurona theory of nervous structure is critically considered. Conferences, assigned readings, and laboratory study. *Twice a week; both semesters.* Assistant Professor Carpenter.

107. Parasitology.—The structure and life history of animal parasites, together with their relations to disease. Conferences and assigned readings with individual laboratory problems. *Two to five times a week; both semesters.* Professor Ward.

113. Experimental Zoology.—Assigned problems in experimental embryology, regeneration, variation, and heredity. The problems are individual and their scope is more or less extended to suit individual needs. *Arrange time; both semesters.* Assistant Professor Zeleny.

117. Faunistic Zoology.—Problems in taxonomy, distribution, and ecology, accompanied by field work, conference, and lectures. The work of this course is favored by a natural history survey of the state now in progress at the University; students have the advantage of the collections, library, apparatus, and operations of this survey as an aid to their personal studies. *Three to five times a week; both semesters.* Associate Professor Smith, Dr. Adams.

121. Individual Research Courses.—

(a) Zoological problems. Professor Ward.
(b) Systematic and faunistic zoology. Associate Professor Smith.
(c) Zoogeography and Animal Ecology. Dr. Adams.
(d) Vertebrate Embryology.
(e) Structure and Development of the Nervous System.
(f) Experimental Zoology. Asisstant Professor Zeleny.

Courses for Graduates and Advanced Undergraduates

3. Microscopical Technique and General Vertebrate Embryology.—Theory and practice of microscopical technique, followed by the study of vertebrate embryos in early stages of development. In the laboratory the student is first trained in the ordinary methods of fixation, embedding, section cutting, staining and mounting. Embryological material will be prepared, and used later in connection with the study of introductory embryology, which completes the course. *Three times a week; first semester.*

6. Vertebrate Organogeny.—A continuation of course 3 intended for medical students and others who desire an acquaintance with the development of the organs of the vertebrate body. The course includes lectures, assigned readings in a text-book of human

embryology, and laboratory studies on embryos of the chick and pig. *Three times a week; second semester.*

7. Structure of the Central Nervous System of Vertebrates.—Lectures and demonstrations intended to acquaint the student with the more important anatomical and histological characters of the vertebrate brain and spinal cord. Stress is laid on the grouping of neurones into functional systems with special reference to the higher vertebrates, including man. *Twice a week; first semester.*

9. Animal Ecology.—Introductory study on the relation of animals to their natural environment. Special stress is laid upon the processes of change in environment and their influences upon animal life. Field trips are made for a study of the local fauna and the conditions under which it lives, and for instruction in methods of observation and the making of notes and collections. In the laboratory the specimens collected are observed and determined, reports are prepared, and a working knowledge of the literature is acquired. Principal attention is given to insects, mollusks, reptiles, amphibians, and fishes. *Five times a week.* Dr. Adams.

11. Principles of Zoogeography.—An introduction to the study of the geography distribution of animals, in which particular attention is given to the faunas of North America and of Illinois. The fauna is considered in its relation to the complete environment—climate, physiography, geology, vegetation, etc.—and from the standpoint of its origin and its dynamic relations; laboratory work on maps, and fields excursions. *Two or three times a week; Saturday excursions to be arranged; first semester.* Dr. Adams.

13. Experimental Embryology and Regeneration.—An analysis of the factors concerned in individual development. Open only to juniors and seniors, except on special permission. Lectures and demonstrations. *Twice a week; first semester.*

Assistant Professor Zeleny.

13a. Experimental Embryology and Regeneration. (Laboratory.)—The application of the experimental method to a definite problem in embryology or regeneration. The work will be individual. *One to five times a week; both semesters.*

Assistant Professor Zeleny.

15. Variation and Heredity.—An analysis of the facts of variation and heredity with reference (a) to the factors of organic

evolution and (b) to the principles of animal breeding. Lectures and demonstrations. *Twice a week; second semester.*

Assistant Professor ZELENY.

15a. VARIATION AND HEREDITY. (Laboratory.)—The application of the experimental method to a definite problem in variation or heredity. The work will be individual. *One to five times a week; both semesters.* Assistant Professor ZELENY.

17a. FIELD ZOOLOGY.—The work is planned to give as comprehensive a knowledge as practicable of the animal life of a restricted locality. Collection, preservation and identification of various kinds of animals, together with observations of the habits and life histories of selected forms, constitute the major part of the work. *Three times a week; first semester.* Associate Professor SMITH.

17c. ADVANCED FIELD ZOOLOGY.—A continuation of 17a and 17b, providing an opportunity for intensive work on more restricted problems in connection with the local fauna. A taxonomic or distributional problem is studied and the work may be made introductory to subsequent investigation in this field. *Three to five times a week; both semesters.* Associate Professor SMITH.

20. CURRENT LITERATURE.—The instructors and advanced students of the department meet at stated intervals as a journal club for the presentation and discussion of the results of recent zoological investigation. This course is open to all qualified students of zoology and should be taken by those intending to graduate with a thesis. *Once a week; both semesters.*

Assistant Professors ZELENY and CARPENTER.

21. INTRODUCTION TO ZOOLOGICAL RESEARCH.—Students looking forward to graduate work and to independent investigation will be assigned definite topics, usually repeating the work of earlier investigators and will be directed in working out the morphology, life history, or reciprocal relations of invertebrate forms. Laboratory work with stated conferences and assigned reading. *Two to five times a week; both semesters.* Professor WARD.

29. ADVANCED ANIMAL ECOLOGY.—A study of special problems in ecology, distribution and faunas, with reference to the interpretations of the relation between animals and their environments. Conferences, laboratory and field work. *Two to five times a week; both semesters.* Dr. ADAMS.

F. Engineering

The degree of Doctor of Philosophy in Engineering is offered in certain lines of academic graduate work of a high scholastic type in engineering science that will attract students who wish to prepare themselves as teachers, investigators and experts.

The general requirements for this degree, as to preliminary education, linguistic attainments, etc., are the same as in other lines.

The following lines of engineering science are open as majors for the present:

Engineering mechanics
Hydraulic and sanitary engineering
Steam engineering
Electrical engineering
Heating and ventilation engineering
Railway engineering
Masonry and structural engineering

The first minor must be one of the following fundamental sciences or an authorized combination of two of them:

Theoretical mechanics
Mathematics
Thermodynamics
Chemistry
Physics (Experimental or mathematical)
Zoology
Botany

The second minor should be in other than engineering subjects.

ARCHITECTURE

Entrance upon graduate work in architecture presupposes the full undergraduate course in that subject. Semi-weekly conferences are held and additional instruction given, in all courses, as may be required.

Courses for Graduates

101. Architectural Construction.—Design of special structures. *Arrange time; both semesters.*

Professors Mann, Ricker and White.

102. Sanitation of Buildings.—The planning of sanitation, warming and ventilation, for buildings of importance. *Arrange time; first or second semester.* Professors Ricker and White.

103. Advanced Architectural Graphics.—Advanced work in graphic statics, stereotomy, perspective, water color, and freehand drawing. *Arrange time; first or second semester.*

Professors Mann, Ricker and Wells.

104. Architectural Design.—Advanced architectural design. *Arrange time; first or second semester.* Professor Mann.

105. Architectural Practice.—Contracts, specifications, and office methods. A study of architectural jurisprudence. *Arrange time; first or second semester.*

Professors Mann, Ricker and White.

106. Architectural History.—Research on special topics, such as: Sources and evolution of architectural forms; origin, development and geographical distribution of architectural styles; effects of function on architectural forms; bibliographical and chronological research. *Arrange time; first or second semester.*

Professors Mann and Ricker.

CIVIL ENGINEERING

Entrance upon graduate work in civil engineering presupposes the full undergraduate course in that subject.

Courses for Graduates

107. Bridge Design.—The determination of the stresses in swing, cantilever, and suspension bridges; and a study of structural details, of shop equipment, and of methods of fabrication. This work may require an inspection of, and report upon, bridge shops or work in progress. *Three to six times a week; first or second semester.* Assistant Professor Dufour.

110. Metallic Building Construction.—The design of the metal skeleton of buildings for various purposes. The work is taught by means of lectures, problems, and inspection of construction work in progress. *Three to five times a week; first or second semester.* Assistant Professor Malcolm.

115. Reinforced Concrete Design.—A study of the materials, the design, the forms, and the erection of reinforced concrete structures. *Arrange time; first or second semester.*

Associate Professor Brooks.

Courses for Graduates and Advanced Undergraduates

6. Masonry and Reinforced Concrete Design.—*Three times a week; second semester.* Assistant Professor Brooks.

15. Advanced Bridge Analysis. *Twice a week; second semester.* Assistant Professor Dufour.

ELECTRICAL ENGINEERING

Entrance upon graduate work in electrical engineering presupposes the full undergraduate course in that subject.

Courses for Graduates

101. Advanced Course in Alternating Currents.—A study of polyphase circuits, alternating current machinery, alternating current measuring apparatus, or a combination of these subjects. *Twice a week; both semesters.* Professors Berg and Brooks.

102. The Generation, Transmission, and Utilization of Electrical Energy.—A study of dynamo-electric machinery, light and power plants, switchboards, and transmission lines. *Twice a week; both semesters.*

Professor Berg, Assistant Professor Paine.

103. Electrical Design.—The development of plans for an electrical machine or apparatus of special character, or for the arrangement of an electrical plant, or for the installation of such machinery or apparatus. *Twice a week; second semester.*

Professor Berg, Assistant Professor Waldo.

104. Telegraphy and Telephony.—*Twice a week; second semester.* Professor Brooks, Assistant Professor Paine.

105. Electrical Engineering Research.—An experimental investigation of some electrical phenomena, or tests of some electrical machine, or of a plant of such machines. *Twice a week; both semesters.* Professor Berg, Assistant Professor Bryant.

106. Illumination.

Professor Brooks, Assistant Professor Bryant.

107. High Tension Investigations Covering Work on Dielectrics, Corona, etc.

Professor Berg, Assistant Professor Bryant.

108. Central Station Economics. Professor Berg.

Courses for Graduates and Advanced Undergraduates

14. Alternating Currents.—*Four times a week; first semester.*

Professor Berg, Professor Brooks, Assistant Professor Paine.

17. Advanced Alternating Currents.—*Four times a week; second semester.*

Professor Berg, Professor Brooks, Assistant Professor Paine.

27. Electrical Engineering Laboratory.—*Twice a week; second semester.* Assistant Professor Bryant.

MECHANICAL ENGINEERING

Entrance upon graduate work in mechanical engineering presupposes the full undergraduate course in that subject.

Courses for Graduates

106. Heat Motors.—Special emphasis is laid on the advanced theory of the internal combustion motor, and of the steam turbine. The general principles and methods of refrigeration are studied. *Twice a week; second semester.*

Associate Professor Goodenough.

107. Thermodynamics.—An advanced study of the general principles of thermodynamics and of their application to the solution of various physical and chemical problems. *Three times a week; first semester.* Associate Professor Goodenough.

109. Machine Design.—A study of the general principles of rational design, with emphasis on the application of mechanics of materials. Individual problems are assigned. *Twice a week; first or second semester.* Assistant Professor Leutwiler.

112. Laboratory Investigations.—This course consists of special investigations of problems relating to combustion of fuel, boiler economy, steam engines and turbines, gas engines and producers, properties of explosive mixtures, mechanical refrigeration, etc. Emphasis is laid upon original work. *Three times a week; first or second semester.* Assistant Professor ————

114. Engineering Design.—The student is required to make a design with estimates and specifications of a complete engineering project, such as a manufacturing plant, a power plant, or a pumping station. *Twice a week; first or second semester.*
Assistant Professor Leutwiler.

Courses for Graduates and Advanced Undergraduates

7. Thermodynamics.—*Three times a week; second semester.*
Professor Goodenough.

MECHANICS, THEORETICAL AND APPLIED

Entrance upon graduate work in theoretical and applied mechanics presupposes a full undergraduate course in that subject.

Courses for Graduates

101. Analytical Mechanics.—This is an extension of the undergraduate course. The foundation of mechanics and its various relations, the methods of treatment and attack, and the study of the more complex problems and applications are taken up. A critical and comparative study of texts is also made. *Twice a week; first semester.* Assistant Professor ————

102. Resistance of Materials.—Advanced work on the properties of materials used in engineering construction and the methods of determining these properties; analysis and investigation in mechanics of materials, including the effect of form of member in a structure or machine and the method of application of forces.

Comparative study of texts may be made. *Twice a week; second semester.* Assistant Professor Moore.

103. Hydraulics and Hydraulic Engineering.—The laws of hydraulics and their application to engineering problems; hydraulic power and its development; design and investigation. *Twice a week; second semester.*

Professor Talbot, Assistant Professor Moore.

104. Experimental Work in Laboratory of Applied Mechancis.—(a) Laboratory investigation in the materials testing laboratory on materials and on their acion as used in machines and structures; (b) experimental work in hydraulic laboratory with pumps, motors, and measuring devices, and the investigation of the laws of hydraulics, the development of power, and the study of various hydraulic problems. *Twice a week; both semesters.*

Professor Talbot, Assistant Professor Moore.

105. Experimental and Analytical Work in Reinforced Concrete.—Research work in reinforced concrete. The interpretation of available experimental results and their application to the design of structures. The principles of construtcion and a study of typical reinforced concrete structures. *Twice a week; both semesters.* Professor Talbot.

MINING ENGINEERING

Courses for Graduates and Advanced Undergraduates

5. Mine Ventilation.—*Three times a week; second semester.* Professor Stoek.

6. Mechanical Engineering of Mines.—*Three times a week; first semester.* Mr. Stevenson.

9. Preparation of Coal and Ores.—*Twice a week; first semester.* Mr. Stevenson.

MUNICIPAL AND SANITARY ENGINEERING

Entrance upon graduate work in municipal and sanitary engineering presupposes a full undergraduate course in that subject.

Courses for Graduates

102. Water Supply Engineering.—Advanced work in water supply engineering will be arranged to fit the conditions of individual classes. Sources and requirements of water supply, general water works construction, pumps and pumping, design of reservoirs and elevated tanks, and water works operation and the valuation of plants are among the topics which may be treated. *One to three times a week; first or second semester.* Professor Talbot.

103. Sewerage.—General sewerage design and construction, a study of sewerage systems, hydraulics of sewers, and a study of run- off, are examples of the work which may be taken up. *Once or twice a week; second semester.* Professor Talbot.

106. Water Purification, Sewage Disposal and General Sanitation.—The design, construction, and operation of water purification plants and of sewage disposal works, the study of existing plants, comparison of results and cost of construction and operation may be taken up in this course. Experimental work on water filters, septic tanks, etc., may be included. Garbage disposal and general sanitation may also be taken. *Once a week; second semester.* Professor Talbot.

RAILWAY ENGINEERING

Entrance upon graduate work in the department of railway engineering presupposes a full undergraduate course in that subject.

The equipment of the department of railway engineering includes a dynamometer car designed for train resistance and locomotive tests on steam roads, and an electric test-car for similar work on electric lines. The department owns also a drop testing machine and a brakeshoe testing machine, both of which conform, in their design, to the standards of the Master Car Builders' Association.

Courses for Graduates

102. Locomotive Design.—Study and analysis of modern practice concerning steam pressure, compounding, superheating, etc. The work in this course may be arranged to suit special requirements of the individual student. *Once a week; both semesters.*

Professor Goss.

106. Locomotive Operation.—Study and determination of train resistance and locomotive tractive effort. The application of these and other matters in the establishment of tonnage ratings. *Once a week; both semesters.* Associate Professor Schmidt.

108. Electric Railway Practice.—This course deals with the design, selection, operation, and maintenance of electric railway equipment. Central station, sub-station, rolling stock, and line equipment are considered. The emphasis is put upon either design or operation according to the training and purpose of the student. *Once a week; both semesters.* Mr. Kendall.

110. Railway Location.—This course is essentially a study of the effects of the location of a railway upon its earning capacity. It deals with the engineering and economic problems met with in original location, as well as in the relocation and reduction of grades of existing lines. *Once a week; both semesters.*

Assistant Professor Roberts.

Courses for Graduates and Advanced Undergraduates

4. Locomotive Performance.—*Twice a week; first semester.* Professor Schmidt, Mr. Williamson.

33. Economic Theory of Railway Location.—*Four times a week; first semester.* Mr. Foote.

64. Electric Railway Practice.—*Three times a week; first semester.* Mr. Kendall.

65. Electric Railway Practice.—*Three times a week; second semester.* Mr. Kendall.

G. Agriculture

AGRONOMY

Students who wish to do their major work in agronomy must have had all the work in that subject prescribed for undergraduates in the college of agriculture of the University of Illinois, or the equivalent. While every one seeking a doctor's degree with agronomy as a major will be required to have a good knowledge of the whole field of agronomy, each student is expected to be especially prepared in some one of the following divisions of the field: Soil

fertility, plant breeding, soil physics, crop production and soil biology.

Students who are taking their major work in other departments and choose agronomy as a minor, must have had previously the work in chemistry, botany and other fundamental sciences prescribed in the undergraduate courses for students of agronomy in the college of agriculture, or the equivalent.

Courses for Graduates

101. Soil Investigation.—A study of systems of soil investigation; sources of error and methods of control; interpretation of results. *Once a week; second semester.* Professor Hopkins.

103. Soil History.—Different systems of agricultural practice and their ultimate effect upon the soil. *Once a week; second semester.* Professor Hopkins.

109. Experimentation in the Production of Field Crops.—The work may include actual practice in planning and conducting field experiments.

112. Plant Breeding.—This course includes a detailed study of experiments at this station, and of methods and results reported from other states and from foreign countries. *Twice a week; both semesters.* Assistant Professor Smith.

118. Investigation.—A special problem is chosen and worked out under the advice and direction of the instructor.

Professor Hopkins, Assistant Professors Smith, Mosier, Pettit.

Courses for Graduates and Advanced Undergraduates

9. Soil Physics and Management.—*Five times a week; first semester.* Assistant Professor Mosier, Mr. Gustafson.

11. Soil Biology.—Soil fertility as influenced by biological agencies. *Three times a week; second semester.* Assistant Professor Pettit.

12. Soil Fertility, Fertilizers, Rotations.—The influence of fertility, natural or supplied, upon the yield of various crops; effect of different crops upon the soil and upon succeeding crops, etc. *Five times a week; second semester.* Professor Hopkins, Mr. Eckhardt, Mr. Fisher.

15. Comparative Agriculture.—*Lectures.* Once a week.
Professor Davenport.

16. German Agricultural Readings.—The current numbers of German journals on agricultural science are required as a text. *Twice a week; second semester.* Professor Hopkins.

22. Plant Breeding.—The improvement by breeding of field crops, including the grains, grasses, and legumes; the principles and methods of selection with critical studies of results obtained by various investigators. Lectures, assigned readings, demonstrations, and laboratory exercises. *Second semester.*
Assistant Professor Smith.

23. Plant Food Supplies.—The world's supply of plant food materials, including methods of utilization. *Once a week; second semester.* Assistant Professor Pettit.

24. Mechanical Composition of Soils.—A study of the mechanical composition of soils and its influence upon granulation, absorption and retention of moisture, and other physical properties affecting crop production. *Arrange time; first semester.*
Assistant Professor Mosier.

ANIMAL HUSBANDRY

Students entering graduate work in animal husbandry should have had a thorough course in the fundamental principles of the subject, substantially equivalent to the prescribed undergraduate work in animal husbandry in this University.

Courses for Graduates

103. Live Stock Experimentation.—Objects, methods and the sources of error in experimental work dealing with the feeding, breeding and management of farm animals. Critical study of live stock experiments at this and other experiment stations. *Once a week; both semesters.* Professor Mumford.

110. Animal Nutrition.—This course includes a thorough study of the chemical and physiological changes, reactions, and processes involved in the activities of animal life, namely mastication, digestion, absorption, assimilation, disassimilation, respiration, circulation, secretion and reproduction. *Three times a week; both semesters.* Professor Grindley

111. Animal Nutrition.—An advanced course for the detailed study of methods employed in the examination and analysis of feeding stuffs and animal substances, including flesh, fat, bone, urine, feces, and manufactured animal products. This is a combined classroom and laboratory course. *Arrange time; both semesters.* Professor Grindley.

112. Bacteriology.—Investigation upon microorganisms related to the animal body in health and disease.

(a) Bacteriology of the digestive tract;

(b) Bovine tuberculosis;

(c) Infectious abortion of cattle. *Arrange time; both semesters.* Dr. Macneal.

116. Seminary.—Reports and discussions of investigations in the field of Animal Husbandry, such as feeding, breeding and economic aspects of live stock production, and the chemical, physiological and bacteriological problems of animal nutrition. *Arrange time; both semesters.* Professor Mumford and others.

Courses for Graduates and Advanced Undergraduates

7. Principles of Animal Nutrition.—*Five times a week; first half of first semester.* Assistant Professor Dietrich.

22. Advanced Stock Judging.—A study of animal conformation with reference to market and show yard form, quality and condition. *Five times a week; second semester.* Various members of the department.

24. Meat.—A study of the influence of type, condition, age, sex and feeds upon the yield and market grade of meat products. *Once a week; second semester.* Assistant Professor Hall.

25. Wool.—The influence of the factors affecting the quality, quantity, strength and condition of wool. *Once a week; second semester.* Mr. Coffey.

26. Swine.—The factors of animal nutrition that have to do with the large and economical production of pork and the determination of type in swine. *Once a week; second semester.* Assistant Professor Dietrich.

DAIRY HUSBANDRY

Courses for Graduates

101. Economic Milk Production.—A special study of differences in the efficiency of dairy cows, cause and effect of the same, and the relation they bear to successful dairy farming. *Twice a week; both semesters.* Professor Fraser.

102. Research.—A careful study of the investigations in progress in the dairy herds of the state. *Twice a week; both semesters.* Professor Fraser.

103. Research.—Dairy feeding problems. *Twice a week; both semesters.* Professor Fraser.

Courses for Graduates and Advanced Undergraduates

7. Factory Management.—Lectures, assigned readings, and laboratory work. *Three times a week; second half of second semester.* Mr. Hepburn, Mr. Lang.

8. City Milk Supply.—Proper methods of handling and preparing milk and cream for direct consumption; preventing contamination, pasteurizing, standardizing, modifying, bottling, transporting, and delivering. Certified milk; value of milk as a food. Milk commissions; legal requirements of cities and states. *First half of second semester.* Associate Professor Rickards.

11. Dairy Bacteriology.—The relation of bacteria to the dairy industry, showing where and to what extent milk may become contaminated and how such contamination may be largely avoided. Methods of determining the bacterial content of milk; detection of pus and pus-producting organisms; the relation of bacteria to the changes that take place in milk; the effect of methods of handling and of temperature upon the bacterial content of milk; the part that bacteria play in the manufacture of butter and cheese. The course consists of laboratory work, lectures and assigned readings. *Second half of second semester.* Associate Professor Rickards.

21. Economic Milk Production.—*Five times a week; second semester.* Professor Fraser.

HORTICULTURE

At least two years of collegiate work in horticulture and allied subjects and the requisite preparation for the chosen topics are required for entrance upon major work in this department.

Courses for Graduates

101. POMOLOGY.—Studies of special problems regarding the relationship, adaptions, improvement, propagation, cultivation, pruning, protection, preservation or marketing of orchard fruits.
Professor BLAIR, Professor CRANDALL.

102. POMOLOGY.—Studies of special problems regarding the adaption, propagation, cultivation, and pruning of small fruits.
Professor CRANDALL.

103. OLERICULTURE.—Studies of special problems regarding the structure, cultural requirements, and improvements of vegetables.
Professor LLOYD.

104. FORESTRY.—Problems in general forestry and investigation of forest growths. Professor BURRILL.

Courses for Graduates and Advanced Undergraduates

7. SPRAYING.—The theory and practice of spraying plants, embracing a study of materials and methods employed in the combating of insects and fungous diseases. *Five times a week; second half of second semester.* Professor LLOYD.

8. ORCHARDING.—A comprehensive study of pomaceous fruits (apple, pear, quince,) and drupaceous or stone fruits (plum, cherry, peach, nectarine, apricot). *Five times a week; second semester.*
Professor CRANDALL.

12. EVOLUTION OF HORTICULTURAL PLANTS.—Comprising a study of organic evolution and the modification of plants by domestication. *Five times a week; second half of first semester.*
Professor CRANDALL.

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UNIVERSITY OF ILLINOIS
GRADUATE SCHOOL

Sept., 1912

TO MEMBERS OF THE FACULTY:

The executive faculty has decided that for purposes of registration and record in the Graduate School, the following plan will be most effective for our purposes. It involves no new educational or administrative principles, but embodies our practice in a somewhat different form. I shall be very grateful if you will kindly read the suggestions, and when you are advising graduate students about their registration next fall, make out their study lists in accordance with the plan.

The plan has reference to graduate work for first year students. The programs of second and third year students must be made out according to the judgment of their advisers as to what they need to round out their preparation for the doctor's degree, subject, of course, to existing rules.

Having regard to the year's work required for the master's degree, kindly note the following points:

1. One full year's work of *graduate grade* is required for the master's degree.

2. Full work should take up all the time that a student may properly be expected to devote to study, and should amount to at least 40 study hours a week. That is, a student should put in at least 40 hours of time on his work each week through the year.

3. A standard or type course, which may be described on the study blank as a unit course, is one which requires 10 hours

of time per week, irrespective of the mode of distribution of that time between class work, laboratory work and private study. The 10 hours may all be spent in the laboratory; two or three of them may be spent in attending lectures, and the other 8 or 7, respectively, in private study; or any other distribution which, in the judgment of the adviser, is necessary for a particular student, or a particular course, may be made. In other words, a unit course may have as many formal, or supervised, class or laboratory exercises per week as in the judgment of the instructor is necessary. Its *value* depends on the fact that it requires ten hours of the student's time, as described above. In any case, when a course is intended to take 10 study hours per week, or ¼ of the student's whole minimum time, it should be entered on the program of studies as 1 unit course.

4. All courses should be recorded either as ¼ unit course, ½ unit course, full unit course, double unit course, etc.

5. Registration for full work therefore ordinarily provides for three unit courses, *or their equivalent*, in addition to a thesis, the time devoted to the thesis being ordinarily reckoned as equivalent to that for one unit or full course; namely, 10 hours' a week of time. If a student is excused from writing a thesis he is expected to take 4 unit courses or their equivalent. This does not mean that he need have 4 separate courses, or 3 separate courses, or 2 separate courses. He may do all his work in one course, but it will be a 4 unit course.

6. A graduate course which requires 2 lecture periods per week of 1 hour each, or 1 lecture period of two hours, will be assumed to require 8 hours of work outside; and will be entered on the records as a unit course, *unless otherwise specified.* Other courses will be rated on this basis unless otherwise specified.

7. A course for graduates and advanced undergraduates, *not open to students below senior grade*, and counting 4 or 5 hours of *undergraduate credit*, may be taken by graduate students as a unit course; such courses, when counting less than 4 hours undergraduate credit, shall be treated as half courses.

8. A course, the prerequisites to which are such as to admit juniors or sophomores, if taken by a graduate student, is

counted as a *half unit or* a *quarter unit* course, unless otherwise indicated in the Graduate School circular or on the student's program.

Under the authority conferred by the faculty on the Dean, no student who is carrying full work as herein described, will be permitted by the Dean to "visit" more than one class, or to take more than one miscellaneous subject.

UNIVERSITY OF ILLINOIS

GRADUATE SCHOOL

Instructions for the Preparation of Masters' and Doctors' Theses

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1. SUBJECT. A thesis subject must be approved by the Head of the Department in which it is written. Arrangements for theses must be made in sufficient time for the Head of the Department to report a list of approved thesis subjects to the Dean by the first Monday in November.

2. TIME OF COMPLETION. *Doctors'* theses must be completed and a typewritten copy in the hands of the Dean by noon of the Saturday nearest the middle of May; *masters'* theses must be completed and a typewritten copy in the hands of the Dean by noon of the first Saturday in June. The instructor in charge may require the thesis as much earlier as he deems necessary. Before the final copy of the thesis is made the student should submit to the instructor in charge a complete draft, which, in all particulars except typographical form, should be as nearly as possible like the finished copy; and the final typographical form should be fully indicated.

Each candidate for a *professional engineering degree* must file an outline of his thesis with the Chairman of the Committee on Advanced Engineering Degrees, on or before December 31st preceding the Commencement at which he proposes to qualify. The completed thesis must be filed with the Engineering Committee not later than April 1.

3. PAPER. In its final form, the thesis must be typewritten upon standard thesis paper, which consists of Crane's Japanese Linen, 17 in. x 22 in.,—24 lb., cut to 8½ in. x 11 in., and ruled as follows: Plain, with double-ruled red border, with one-half inch margin on top, right-hand side and bottom, and one inch margin on the left-hand side, making plate 7 in. x 10 in. inside of border.

Diagrams may be platted upon cross-ruled paper, but the sheets must be of the above size or larger; and if the sheet is larger than standard thesis paper, it must be folded to substantially that size.

4. ILLUSTRATIONS. The illustrations may consist of diagrams, drawings, and photographs (preferably bromide prints), or, if necessary, of blue prints or other forms of reproduction which meet the approval of the instructor in charge.

Drawings upon folded sheets may be inserted if necessary. If a folding sheet is employed, it should be of thin bond paper, and should be as small as is consistent with legibility; great care must be exercised in folding it, so that it may readily be unfolded after the thesis has been bound, and also so that it will not be cut when the thesis is trimmed by the binder.

5. Copying the Thesis. The thesis must be neatly typewritten. Indelible black ink or black record ribbon should be used. The wide margin of the paper must be at the left hand; and in no case should the writing be outside of the red-line border. The writing should begin near the left-hand border line, and this margin should be uniform. The right-hand margin should be as uniform as possible. The pages should be numbered at the center of the top or at the upper right-hand corner inside of border. Where there is any intention or necessity of printing the thesis later, as in the case of a doctor's thesis, a carbon copy should be made, as the copy deposited with the Dean for binding and preservation in the library cannot be withdrawn for the printer's use.

6. Title Page. The title page must be printed in accordance with the model shown below. The model gives both style and size

(1) ACOUSTICS OF AUDIENCE ROOMS

(2) BY

(3) WALTER FRANCIS SMITH

(4) B. S. University of Illinois, 1903.

---

(5) THESIS

(6) Submitted in Partial Fulfillment of the Requirements for the

(7) Degree of

(8) DOCTOR OF PHILOSOPHY

(9) IN PHYSICS

(10) IN

(11) THE GRADUATE SCHOOL

(12) OF THE

(13) UNIVERSITY OF ILLINOIS

(14) 1908

NOTE:—Lines 1, 4, 5, 6, 7, 8, 13, 14 are 12 point Antique type; lines 2, 10, 12 are 8 point; lines 3, 9, 11 are 10 point.

of type. Proofs of the title page should be submitted for the approval of the instructor in charge before being printed.

7. CERTIFICATE. The manuscript of the thesis must be accompanied with a certificate of approval. For masters' theses this approval must be given by the person under whose immediate supervision the thesis was prepared, and also by the Head of the Department. In the case of doctors' theses, the approval must be by the person under whose immediate supervision the thesis is prepared and the committee on final examination. This certificate is to be prepared by the member of the faculty in charge of the thesis, upon a blank obtained at the office of the Dean of the Graduate School.

8. TABLE OF CONTENTS. Each thesis must have a table of contents; the Roman numbers I, II, etc., should precede the titles of the subdivisions; the table of contents may be accompanied with a list of tables, figures, and plates with their serial numbers and the number of the page upon which each is found.

9. ARRANGEMENT. The usual make-up of a printed book should be followed in the opening pages. First should come the title page, followed immediately by the certificate; next should be placed the table of contents, entire. The headings for chapters or other main subdivisions, as indicated by the table of contents, should be inserted in their proper places throughout the thesis, just as chapter headings appear in a printed book. These should be preceded by the Roman numerals I, II, etc.

10. VITA. Each doctor's thesis must have an appendix giving a short biography of the candidate, including the institutions he has attended, his degrees and honors, the titles of his publications, teaching or professional experience, and such other matters as may be pertinent.

11. PUBLICATION. Both the results of the investigation and the completed thesis are the property of the University, and no portion of either may be published except by permission of the Dean of the Graduate School.

12. PRINTED THESES. Thesis manuscript in condition for the press, the publication of which has been provided for, may be accepted as fulfilling the thesis requirement for graduation upon the recommendation of the Head of the Department in which the work is done and assurance that printed copies will be filed with the Librarian of the University by a specified date.

13. PRINTING. The doctor's thesis must be printed and one hundred copies deposited in the Library of the University not later than the first of June preceding the conferring of the degree. If it is not printed by the first of June, the student must deposit seventy-five dollars ($75) or a bond for that amount satisfactory to the Comptroller of the University and the Dean of the Graduate School. If a bond is accepted, it must be replaced at the end of one year with a cash deposit. At the end of two years, if the thesis has not then been printed by the student, the University will print such part of it as it deems best. [In effect Sept. 1913]

The cash deposit made by the student who does not print his thesis by the end of the second year after his degree is conferred becomes the property of the University, to be used for the general purpose of printing theses, and all graduate students who receive their degrees must agree at the time when the deposit is made that the University shall become the owner of this deposit for this purpose. [In effect Sept. 1913.]

GRADUATE WORK IN ENGINEERING

UNIVERSITY OF ILLINOIS

1912-13

URBANA-CHAMPAIGN, ILLINOIS

PUBLISHED BY THE UNIVERSITY

heated steam will serve to increase its power; and a more perfect understanding of the thermodynamic principles involved by its action will help to disclose a way for raising its thermal efficiency. Such considerations lift the problem of locomotive design far above mere routine and make its success dependent upon the skill of the exceptional man who knows.

Similar conditions confront the engineer in every field of endeavor. In architecture, in the applications of electricity, in mining, in the organization and management of the foundry and machine shop, in the professorial chair of the college, in the fields of scientific investigation, and in the development of great public movements, such, for example, as vocational education, which grow out of or are closely identified with the engineering practice of the day—everywhere there is a demand for men who can bring broad and inspiring conceptions to their work. There are never enough men who can successfully cope with the exceptional tasks.

II. The College a Stepping Stone

The man who is to perform the exceptional task, who is to succeed as a research worker, who is to have expert control in the work of great corporations, and who in any line of activity is to be a factor in pushing the science of engineering to higher stages of development, needs exceptional training. As a basis for this training, a four years' technical course is not always sufficient, and such courses are now being supplemented in various ways. Some institutions have offered a preliminary academic course of three or four years' duration, followed by such engineering work as has long characterized the undergraduate courses of the technical school. Such technical work has been sometimes referred to as graduate work in engineering. Other institutions have offered a fifth year of technical work following the usual four years' course in engineering, an arrangement which has given an extension of training by the addition of more work which has been similar in character to that of the normal four years' course.

III. Graduate Work at the University of Illinois

The University of Illinois is attempting to secure for its students in engineeering the advantages of superior training by a different way of approach. It has not been content to limit the scope of its engineering work to those undertakings common to a four years' course, however thoroughly the student may be prepared for such work, neither has it been content to offer engineering work of greater variety, but entirely of undergraduate grade. Its way of approach is through the administration of its Graduate School whose activities follow those of a regular four years' course in engineering and are so highly scientific in character as to require the work of the preceding four years as a preparation. It has outlined work in certain general fields of engineering which at present include:

Architecture
Engineering Mechanics
Hydraulics and Sanitary Engineering
Steam Engineering
Electrical Engineering
Heating and Ventilating Engineering
Railway Engineering
Masonry and Structural Engineering
Mining Engineering

Graduates of the usual four years' course in engineering, who have the degree of Bachelor of Science or its equivalent, may proceed with work along one or more of these lines to the master's degree, which may be obtained after one year of graduate work, or to the doctor's degree, which may be obtained in two years after the master's degree. The College offers a number of definitely organized courses in the above fields, in the administration of which the emphasis is varied to suit the training and aim of the individual student. After the general field is selected, the subjects are arranged with reference to the student's peculiar needs, the purpose being to afford him the broadest possible outlook. If he prefers, he may combine with his major subject others as minors which will tend to increase his understanding of fields outside of that in which he has chosen to specialize. The work in all its aspects takes advantage of the previous preparation of the student and is designed to be of a

highly scientific character. For example, a graduate student, pursuing work in steam engineering, will usually give time not only to the higher phases of thermodynamics, but to physics and mathematics, since these constitute the channels through which the phenomena of most interest to him must be interpreted. He may also do work in language or philosophy that his intellectual powers may be further broadened and strengthened. In a similar manner the graduate student in electrical engineering gives serious attention to the more complex phases of electrical phenomena, to higher mathematics, and to advanced physics. If he is interested in power development, he may also give attention to hydraulics or to thermodynamics; if interested in electrochemistry, to chemistry and metallurgy.

IV. Laboratory Facilities and Professorial Leadership

It is evident that such work in engineering as is implied by the preceding outline presupposes the possession of extensive laboratory facilities and of adequate professorial leadership. The Trustees of the University of Illinois have sought to meet both of these requirements. The laboratories of the College of Engineering and of its allied departments include:

1. Architectural Drafting Rooms and Library
2. Cement Laboratory
3. Ceramics Laboratories
4. Civil and Mechanical Engineering Drafting Rooms
5. Coal-Dust and Mine-Gas Laboratories
8. Electrical Laboratories
7. Hydraulic Laboratory
8. Materials Laboratories
9. Locomotive Testing Laboratory
10. Mining Laboratory
11. Mine Rescue Laboratory
12. Road Materials Laboratory
13. Mechanical Engineering Laboratory
14. Shop Laboratories
15. Transportation Laboratories

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16. Physics Laboratory
17. Chemistry Laboratory
18. Geology Laboratory
19. Biology Laboratory

All of these laboratories are briefly described in the University Register. Prospective students desiring detailed information concerning any one of them should address the Dean of the Graduate School.

The representatives of the College of Engineering who are accredited to the work of the Graduate School are well known either as teachers or research workers in their respective fields. The list is as follows:

William Freeman Myrick Goss, M. S., D. Eng.	Dean, College of Engineering

---

Ira Osborn Baker, C.E., D.Eng.	Civil Engineering
Ernst Julius Berg, M.E., Sc.D.	Electrical Engineering
Morgan Brooks, Ph.B., M.E.	Electrical Engineering
John Myron Bryant, E.E.	Electrical Engineering
Alonzo Morris Buck, M.E.	Railway Electrical Engineering
Frank Oliver Dufour, C.E.	Structural Engineering
George Alfred Goodenough, M.E.	Thermodynamics
Oscar Adolph Leutwiler, M.E.	Machine Design
Charles Wesley Malcolm, C.E.	Structural Engineering
Frederick Maynard Mann, M.S., C.E.	Architecture
Herbert Fisher Moore, M.M.E.	Theoretical and Applied Mechanics
Ellery Burton Paine, M.S., E.E.	Electrical Engineering
Charles Russ Richards, M.E., M.M.E.	Mechanical Engineering
Nathan Clifford Ricker, M.S., D.Arch.	Architecture
Edward Charles Schmidt, M.E.	Railway Engineering
Harry Harkness Stoek, E.M.	Mining Engineering
Arthur Newell Talbot, C.E.	Theoretical and Applied Mechanics; Municipal and Sanitary Engineering
David Varon, A.D.G.F.	Architectural Design
Edward Hardenbergh Waldo, A.B., M.E.	Electrical Engineering
Newton Alonzo Wells, M.P.	Architectural Decoration
James McLaren White, B.S.	Architectural Engineering

Charles Richard Clark, B.S.	Architectural Construction
Francis Seeley Foote, Jr., E.M.	Railway Civil Engineering
Francis Church Lincoln, Ph.D.	Mining Engineering

V. Research as Promoted by the Engineering Experiment Station

The activities of the various engineering laboratories and the opportunities afforded those who have work in them are enhanced through the operation of the Engineering Experiment Station. The Station is organized to promote engineering research. Its work is directed by the heads of departments of the College of Engineering, and its results are presented from time to time in the form of Engineering Experiment Station bulletins. Sixty such bulletins have thus far been published. The information which they have presented has served to advance practice in such important matters as reinforced concrete design, the storage and utilization of fuels, the theory of the gas producer, and conditions affecting steam-engine performance.* The activities in the various laboratories growing out of the progress of such work supply an atmosphere which is exceedingly stimulating to graduate students, and provide for them many opportunities to share in advanced research.

*A complete list of the bulletins thus far published will be sent on application to the Director of the Engineering Experiment Station, University of Illinois.

VI. Students Enrolled in Graduate Work

The following is a list of those enrolled as graduate students in residence for the year 1911-1912, with a statement of the field in which each one is working:

Angelo Corrubia, B.S., Architecture
Karl John Theodore Ekblaw, B.S., Architecture
Edward John Lake, B.S., Architecture
Edward Roy Ludwig, B.S., Architecture, Architectural Graphics
Mikischi Abe, Bachelor of Civil Engineering, Civil Engineering, Economics
George Paul Boomsliter, B.S., Civil Engineering, Theoretical and Applied Mechanics, Mathematics
Floyd Hays Millard, B.S., Civil Engineering, Mechanical Engineering
Raymond Jefferson Roark, B.S., Civil Engineering.
Arvid Robert Anderson, B.S., Electrical Engineering, Mechanical Engineering
Charles Thomas Anderson, B.S., Electrical Engineering, Mechanical Engineering
Clair Elmore Anderson, B.S., Electrical Engineering
Claudius Edmund Bennett, B.S., Electrical Engineering, Mechanical Engineering
Charles Day Black, B.S., Electrical Engineering, Mechanical Engineering
Mati Lal Dutt, B.S., Electrical Engineering
Ira Wilmer Dickerson, B.S., Electrical Engineering, Mechanical Engineering, Agronomy
Stanley Prince Farwell, B.S., E.E., Electrical Engineering, Mathematics, Theoretical and Applied Mechanics
Ira William Fisk; B.S., Electrical Engineering
Fred J. Gray, B.S., Electrical Engineering, Mechanical Engineering
Owen E. Grigsby, B.S., Electrical Engineering, Mechanical Engineering
Laurence Richard Gulley, B.S., M.S., Electrical Engineering, Mathematics, Economics
Leonard Vaughan James, B.S., Electrical Engineering
Mayne Seguine Mason, B.S., Electrical Engineering, Mechanical Engineering
Melvern D. Overmier, B.S., Electrical Engineering, Mechanical Engineering
William Fred Schaller, B.S., Electrical Engineering, Mechanical Engineering, Economics

Hubert Michael Turner, B.S., Electrical Engineering, Mathematical Physics
Edward H. Waldo, A.B., M.E., Electrical Engineering, Chemistry
Frank Gardner Willson, B.S., Electrical Engineering
Trygve D. Yensen, B.S., Electrical Engineering, Mechanical Engineering
Archie Stanton Buyers, B.S., Mechanical Engineering
John Adlum Dent, M.E., Mechanical Engineering, Mathematics
William Earl Mosher, Ph.D., Mechanical Engineering
Ray Boyd Ponder, B.S., Mechanical Engineering, Electrical Engineering
Fred B. Seely, B.S., Mechanical Engineering, Theoretical and Applied Mechanics, Mathematics
Clarence Eugene Noerenberg, A.E., Mechanical Engineering, Mathematics, Physics
Harold Allen Houston, B.S., Railway Engineering, Economics
Willard Clarke Eells, B.S., Theoretical and Applied Mechanics
Melvin Lorenius Enger, B.S., C.E., Theoretical and Applied Mechanics
Newton Edward Ensign, B.S., Theoretical and Applied Mechanics, Mathematics
Virgil R. Fleming, B.S., Theoretical and Applied Mechanics
Harrison Frederick Gonnerman, B.S., Theoretical and Applied Mechanics, Economics
Hubert Leonard Olin, A.B., Chemistry, Ceramics

VII. Researches of Graduate Students

The character of the work done by graduate students will be suggested by the subjects of theses prepared for either the master's or the doctor's degree. The following list covers investigations for the last three years:

Mechanical Stresses in Transmission Lines
The Cost of Heating Buildings from a Central Heating Station by Direct Low-Pressure Steam
A Study of the Comparative Economy of the Usual Types of Steel Roof Trusses
The Application of Color to Antique Grecian Architecture
An Investigation of a Special Case of Rotary Converter Hunting
Comparative Cost of Interior Lighting by Various Illuminants
The Determination of Stresses in a Reinforced Concrete Member Subject to Axial Load and Flexure
A Study of Reinforced Concrete Slabs
Spark Discharge at Very Small Distances
Magnetic Properties of Heusler Alloys
Magnetic Properties of Certain Rare Earths
A Second Investigation of the Transporting Capacity of Currents of Water
Economic Development of Bridge Construction
High Potential Tests of Insulation
An Investigation of Transformer Reactance
Short Circuit of Alternators
A New Method of Analyzing the Cylinder Performance of Reciprocating Engines
The Principles of Cost Accounting as Applied to Machine Shops
Frequency Measurements in Wireless Telegraphy
The Magnetic Properties of Cobalt, with Especial Reference to their Interpretations on the Electron Theory and the Theory of Intrinsic Molecular Field
The Energy, Loss and Self Induction in Steel Wires Carrying A. C. Currents
Calculation and Design of Alternating Current Electro-Magnets for Lifting and Other Special Purposes
An Investigation of Reinforced Steel Columns
Webb Stresses in Reinforced Steel Beams
A Design of an Acyclic Turbo-Generator Set
Ionization and Photo-Electric Properties of Vapors of Alkali Metals.
The Study of the Velocity of Electrons in Photo-Electric Effect, as a Function of the Wave-lengths of the Light
Conditions of Sensibility of Photo-Electric Cells with Alkaline Metals and Hydrogen

The Determination of e/m and v for Cathode Rays by the Photographic Method
Accuracy of Electric Metering
The 15 Watt Tungsten Lamp.
Characteristics of Steel Wire for Transmission Lines
Pontential Stresses in Dielectrics
A Direct Current Compensator Dynamo
Theory of the Ignition Coil
Construction of a High Speed Gas Engine Indicator
Theory of Short Circuits in Alternaters
A Study of the Transient Period in a Tuned Circuit
Reactance of Alternators
Characteristics of Copper Clad Steel Wire
A Study of the "Building up" of a Direct Current Generator
Hunting of Synchronous Machines
The Effect of Interpoles on Commutation
The Transient Hysteresis
A Study of Harmonics in Three Phase Transformers
A Study of Iron Alloys
A City Plan for Minneapolis and St. Paul
Metallic Compression Members
A Study of By-Axial Compression in Concrete

For further information address

Dean of the Graduate School
University of Illinois
Urbana, Illinois

THE GRADUATE SCHOOL

OF THE

UNIVERSITY OF ILLINOIS

ANNOUNCEMENT FOR

1912-1913

URBANA-CHAMPAIGN, ILLINOIS
PUBLISHED BY THE UNIVERSITY

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THE UNIVERSITY CALENDAR, 1912-13

As applicable to the Graduate School

First Semester, 1912-13

1912

Sept. 16, 17, Monday and Tuesday	Registration days
Sept. 18, Wednesday, 8 a. m.	Instruction begins
Nov. 4, Monday	Latest day for submission to Dean of all thesis subjects as approved by heads of departments
Nov. 27, Wednesday, 12 m.	Thanksgiving recess begins
Dec. 2, Monday	Illinois Day, half holiday
Dec. 21, Saturday, 12 m.	Christmas Holiday recess begins
Dec. 31, Tuesday, 5 p. m.	Latest date for submission of outlines of theses by candidates for professional degrees in engineering

1913

Jan. 3, Friday, 12 m.	Instruction resumed
Jan. 23, Thursday, 8 a. m.	Semester examinations begin

Second Semester, 1912-13

Feb. 3, 4, Monday and Tuesday	Registration days
Feb. 5, Wednesday, 8 a. m.	Instruction begins
Feb. 12, Wednesday	Lincoln Day
March 20, Thursday, 12 m.	Easter recess begins

March 25, Tuesday, 12 m.	Instruction resumed
April 1, Tuesday, 5 p. m.	Latest date for filing with Engineering Committee completed theses by candidates for professional degrees in engineering
May 17, Saturday, 12 m.	Latest date for receipt by Dean of certified doctors' theses
May 29, Thursday	Semester examinations begin
June 7, Saturday, 12 m.	Latest time for receipt by Dean of certified masters' theses
June 8, Sunday	Baccalaureate day
June 10, Tuesday	Alumni day
June 11, Wednesday	Forty-second annual commencement

THE EXECUTIVE FACULTY

OF THE GRADUATE SCHOOL

EDMUND JANES JAMES, PH. D., LL. D., PRESIDENT OF THE UNIVERSITY.

THOMAS JONATHAN BURRILL, PH. D., LL. D., *Vice-President, Professor af Botany.*

DAVID KINLEY, PH. D., LL. D., *Dean of the Graduate School and Professor of Economics*

ALBERT PRUDEN CARMAN, A. M., SC. D., *Professor of Physics.*

WILLIAM FREEMAN MYRICK GOSS, D. ENG., *Dean of the College of Engineering, Director of the School of Railway Engineering and Administration and of the Engineering Experiment Station.*

GUY STANTON FORD, PH. D., *Professor of Modern European History.*

GEORGE ABRAM MILLER, PH. D., *Professor of Mathematics.*

WILLIAM ALBERT NOYES, PH. D., *Professor of Chemistry and Director of the Chemical Laboratory.*

JULIUS GOEBEL, PH. D., *Professor of Germanic Languages.*

HENRY BALDWIN WARD, PH. D., *Professor of Zoology.*

ARTHUR NEWELL TALBOT, C. E., *Professor of Municipal and Sanitary Engineering.*

STUART PRATT SHERMAN, PH. D., *Associate Professor of English and Chairman of the Committee of the Department of English.*

BOYD HENRY BODE, PH. D., *Professor of Philosophy.*

HERBERT WINDSOR MUMFORD, B. S., *Professor of Animal Husbandry.*

JAMES HARVEY PETTIT, PH. D., *Assistant Professor of Soil Fertility.*

WILLIAM ABBOTT OLDFATHER, PH. D., *Associate Professor of Classics.*

HISTORY AND ORGANIZATION

Although for many years the University of Illinois had offered advanced students facilities for study and research in various lines, graduate work was undertaken under the name of the Graduate School for the first time in 1892. In 1894 the administration of the school was vested in the Council of Administration and the Vice-President of the University became Dean of the School. In 1906 the Graduate School was organized as a separate faculty, consisting of a dean and members of the University faculty assigned to this duty by the President. No means of support, however, were provided, separate from those provided for the undergraduate work. In the winter of 1906-7, the Forty-fifth General Assembly of the State passed an act appropriating $50,000 per year for the support of a Graduate School of the Arts and Sciences in the State University. This appropriation has been continued by succeeding Legislatures.

By act of the Trustees the teaching faculty of the Graduate School includes all members of the University faculty who give instruction in courses approved for graduate credit. The affairs of the School, however, are in charge of the executive faculty appointed each year by the President.

ADMISSION

For admission to the Graduate School to work for a degree an applicant must hold a first degree either from the University of Illinois or from some other university or college of equivalent standing. Admission to particular graduate courses or departments may be secured only by those who have had the requisite undergraduate work in those courses or departments.

In order to be enrolled as a member of the Graduate School a student must be doing graduate work. The posession of a first degree does not entitle a student to be enrolled in the Graduate School, if the courses which he is taking are undergraduate.

Students of mature age who do not hold a first degree, but satisfy the dean of the school and the officers of the de-

partments in which they wish to work of their earnestness of purpose and special fitness, may be permitted to take work in the Graduate School without reference to candidacy for a degree. In order to secure this permission, however, a candidate must have had such preliminary preparation for the work he wishes to take up as would justify his admission to the Graduate School as a candidate for a degree if he could meet the other requirements fully.

Application blanks for admission may be secured from the Dean of the Graduate School or from the Registrar of the University.

REGISTRATION

After the student's application for admission has been approved, he receives from the Dean a permit to register and also a study blank. This study blank must be filled out with the advice of the professor in charge of the selected work.

Each student is required to attend a minimum of four class, lecture, or laboratory, exercises, per week, in the first year of his graduate study; and in no case is he permitted during his course to attend more than twelve per week.

Residence.--Continuous residence and study are required of all members of the Graduate School, unless they are granted leave of absence by the Dean, upon recommendation of the professors in charge of their work, for the purpose of carrying on elsewhere studies or investigation in the line of work for their degrees.

CHARACTER OF GRADUATE WORK

The principal aim of graduate study is the development of the power of independent work and the promotion of the spirit of research. Each candidate for a degree is expected to have a wide knowledge of his subject and of related fields of work; for the graduate student is not expected to get from lecture and laboratory courses all the knowledge and training neccessary to meet the requirements for his degree.

Students are warned against restricting themselves merely

to the courses prescribed or suggested by the departments in which they are studying. Each student is expected to do a wide range of private reading and study; and in many cases will find it advisable to take one or more courses of lectures quite outside the field of his chosen subjects.

THE MASTER'S DEGREES

Candidates for the degree of Master of Arts or Master of Science are required to do at least one year's work in residence and to write a thesis.

A candidate for a master's degree may do all his work in one subject, or he may select a major and one minor, or a major and two minors. A major or minor denotes the field of knowledge of a department, or such part thereof as constitutes a separate and independent division of that field. The candidate must do at least half his work in his major subject.

Each candidate for a master's degree is also required to present a thesis on some subject approved by the professor in charge of his major work and the Faculty of the School. The requirement of a thesis may be waived, however, upon the recommendation of the head of the department in which the student is doing his major work, and the approval of the Dean, provided application to waive the thesis is made at the beginning of the year. *In no case will permission to take the degree without a thesis be given if applied for later than the latest date for the approval of thesis subjects, as shown by the calendar.*

The thesis required from a candidate for a master's degree ordinarily will demand about one-fourth of the student's time. The thesis must be type-written, on "thesis paper", and the title-page must be printed. The thesis, in its final form, together with a certificate of approval by the proper officer, must be left by the student at the Dean's office at the time set in the calendar.

Credit is not given for work done in other universities The candidate is examined here on the subjects offered by him for the advanced degree.

The Master's Degree in Engineering

Two classes of master's degrees are open to graduates of the College of Engineering, namely, academic and professional.

The *academic* second degree in engineering is Master of Science, following Bachelor of Science, in Architecture, Architectural Engineering, Civil Engineering, Electrical Engineering, etc. This degree is conferred in accordance with the regulations described above *for academic work in residence only.*

The *professional* second degrees in engineering are as follows:

Master of Architecture after B. S. in Architecture.

Architectural Engineer after B. S. in Architectural Engineering.

Civil Engineer after B. S. in Civil Engineering or B. S. in Municipal and Sanitary Engineering.

Electrical Engineer after B. S. in Electrical Engineering.

Mechanical Engineer after B. S. in Mechanical Engineering.

Civil Engineer, Electrical Engineer or Mechanical Engineer, after B. S. in Railway Engineering, according to the course.

Professional degrees are conferred upon two classes of candidates: 1. Graduates of the College of Engineering of the University of Illinois who have been engaged in acceptable professional work away from the University for a period of not less than three years after receiving the degree of Bachelor of Science. 2. Graduates of the University of Illinois, or of institutions of equal standing, who have been engaged in acceptable professional work in residence at the University for a period of not less than three years after receiving the degree of Bachelor of Science.

In "acceptable professional work" may be included contributions to technical literature, activity in professional societies, investigations of engineering problems, and the teaching of engineering subjects.

A candidate must declare his candidacy and file with the Dean of the College of Engineering, as chairman of the committee in charge, a detailed statement covering his professional study and experience, not later than the first Monday in

November preceding the commencement at which he proposes to qualify. Prior to December 31 next succeeding, he must submit for approval an outline of his proposed thesis and he must file his completed thesis not later than April 1. If the statement of professional experience and study and the thesis are accepted, the candidate must present himself at commencement in order to receive the degree.

Candidates for professional engineering degrees who already hold the degree of Master of Science, may qualify for the professional degree after two years of professional work.

THE DEGREE OF DOCTOR OF PHILOSOPHY

General Statement of Requirements.—The requirements for the degree of Doctor of Philosophy are a thorough mastery of a selected field of study, evidence of the power of independent investigation in this field, a broad knowledge of the wider field of study of which this major subject is a part, a general acquaintance with related fields of knowledge and a mastery of all branches of study which are necessary to a full knowledge of the main subject. Each student who is seeking this degree is expected to choose for study and final examination a major subject, or field of study, and a first and second minor. The major subject is the field in which the student expects to become expert and an authority. The first minor must be a subject closely related to the major and may, under certain conditions and with proper approval, be a sub-division of the major field of study. The second minor should be chosen outside of the major field of study.

When a candidate chooses any subject as his major, and a division of that subject as his minor, he is not permitted to choose as a second minor any division of work in that same department, excepting by vote of the executive faculty of the School.

The candidate's list of subjects must receive the approval of the head of the department in which he chooses his major work and of the Dean of the School.

Period of Study.—The *minimum* period of study required

for securing the degree of Doctor of Philosophy is three years. The degree is conferred, however, not for residence during a certain period, but for scholarly attainments and power of investigation, as proved by thesis and examinations.

Candidates should note that credit is not given for work done in other universities, excepting in the sense that their residence at other institutions is counted towards the residence requirement for the doctor's degree.

At least the first two or the last one of the three years required must be spent at this University.

Examinations.—Towards the end of his second year of study, or, by special permission, at the beginning of his third year, the candidate for the degree must submit to a preliminary examination conducted by the members of the faculty with whom he is doing his principal work, in order to determine whether he will be accepted as a candidate for the degree in the following year. This examination is partly oral, and may be wholly so. At this time, or before, the candidate will be required to demonstrate his ability to read French and German, and any other language needed for the prosecution of his work.

On or before the last Monday in May of the year in which the candidate expects to come up for his degree, he must submit to a final examination by a committee appointed by the Dean of the Graduate School. This examination will be partly written. The candidate will also have, however, an oral examination. These examinations will not be confined to the courses which the candidate has attended in the University of Illinois only, if he has done part of the work elsewhere; nor even to the field covered by the courses specifically taken in this or other universities; but will be so conducted as to determine whether the candidate has a satisfactory grasp of his major subject as a whole, and a general acquaintance with the broad fields of knowledge represented by his course of study.

Before the candidate is admitted to the final examination and the defense of his thesis, he may be required to take any other examination, oral or written, that is thought proper by the various departments in which he has studied. If after

having passed his preliminary examination, he fails in the third year of his study to meet the expectations of the professors in charge of his work, or in any way fails to maintain the standard of scholarship and power of research expected of him, he may be refused admission to the final examination.

The final examination in the major and minor subjects may not be divided. The examination must be taken all at one time even though it requires several sessions.

Thesis.—The power of independent research must be shown by the production of a thesis on some topic connected with the major subject of study. The candidate is expected to defend his thesis or dissertation before the members of the faculty, or as many of them as may wish to question him about it, in connection with his final examination.

The subject of the thesis should be chosen not later than the end of the second year of study and must be submitted for formal approval by the faculty not later than the first Monday of November of the year when the degree is expected. A typewritten copy of the complete thesis, on thesis paper, with proper certificate of approval, must be in the hands of the Dean not later than noon of the Saturday nearest the middle of May.

The thesis must be printed and one hundred copies deposited in the library of the University before the degree is conferred. If, for any reason, the thesis cannot be printed and one hundred copies deposited before commencement time, the candidate must, before the first Monday in June, deposit a bond acceptable to the Comptroller of the University and the Dean of the Graduate School for the cost of printing his thesis, or such part thereof as may be regarded as sufficient to meet the requirements of the rules.

The title page of each thesis must bear the words "Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in—(here put the major subject), in the Graduate School of the University of Illinois." The title page must also contain the full name of the author, the full title of the thesis, the year of imprint, and, if a reprint, the title, volume and statement of the pagination of the volume from which it is reprinted. Each thesis must have an appen-

dix giving a short biography of the candidate, including the institutions he has attended, his degrees and honors, the titles of his publications, and such other matters as may be pertinent.

SCHOLARSHIPS AND FELLOWSHIPS

A number of fellowships and scholarships have been established by the Trustees of the University. To first year graduate students of ability and promise there are open a number of scholarships with a stipend of $250 each and freedom from tuition, incidental and laboratory fees. To second and third year graduate students, that is, those who have had one or two years of graduate study, there are open fellowships with a stipend varying from $300 to $500, with freedom from fees. The larger stipends are given only to students who are expected to take their degrees within the year. Each holder of a fellowship or scholarship must pay the matriculation fee of ten dollars, unless he holds a first degree from the University of Illinois, and also the diploma fee of five dollars on receiving his diploma.

Candidates for these scholarships and fellowships must be graduates of the University of Illinois, or of colleges or universities having equivalent requirements for bachelors' degrees.

Application must be made upon blanks to be obtained from the Dean of the Graduate School. These application forms should be addressed to the Dean of the Graduate School as early as possible in February of the academic year preceding that for which the fellowship is desired.

Persons appointed are required to send the Secretary of the Board of Trustees prompt notice of their acceptance or refusal; and to agree that, if accepted, the appointment will not be resigned to take a similar one in any other institution during the year for which it is awarded.

Nominations to fellowships are made upon the grounds of worthiness of character, scholastic attainments, and promise of success in the principal line of study or research to which the candidate proposes to devote himself.

Scholarships and fellowships are good for one year, but

may be renewed for a second or a third year in special cases. An appointment as honorary fellow, without stipend, may be made as specified for paid fellowships in the case of any one who has shown distinguished merit in his work.

Research Fellowships in the Engineering Experiment Station

The Engineering Experiment Station is devoted entirely to research. Its purposes are the elevation of engineering education, and the study of problems of special importance to engineers and to manufacturing, railway, mining, and industrial interests.

Ten fellowships, each of five hundred dollars a year, have been established in the Engineering Experiment Station. Applicants to whom these fellowships are awarded are required to agree to hold them for two years, devoting a part of their time to the work of the Engineering Experiment Station. Application for these fellowships should be made to the Director of the Engineering Experiment Station.

LIBRARIES

The general University library, the library of the State Laboratory of Natural History, that of the Agricultural Experiment Station, and that of the College of Law are all at the University in Urbana. The library of the School of Pharmacy is in Chicago.

The general University library contains 217,000 volumes and 45,000 pamphlets. The University has a subscription list of 1,967 periodicals. The library of the State Laboratory of Natural History contains 7,450 volumes and 18,200 pamphlets. The library of the College of Law contains the Federal and State Reports, the leading textbooks, and a line of leading periodicals, aggregating more than 12,000 volumes. The department of education has made a special collection of about 1,500 books and 3,550 pamphlets, which are kept in the rooms of the department in University Hall. This collection contains a very good assortment of modern text books, and

copies of the courses of study of nearly all the large city school systems.

The general library of the University is open daily, from 8 a. m. until 10 p. m. and on Sunday from 2 p. m. to 6 p. m.

The Mason Historical Library.—The valuable library of western history collected by Edward G. Mason, Esq. long president of the Chicago Historical Society, is in the Public Library of the city of Champaign, and is accessible to University students.

The Dittenberger Classical Library.—The University possesses the library of Wilhelm Dittenberger, at one time Professor of Classical Philology in the University of Halle. This library contains 5,600 items and is especially valuable for the literary study of the classical languages. It includes, in the best editions, the works of the poets and prose writers, both Greek and Latin, and numerous works on grammar and history of literature, with between four and five thousand dissertations and programs on special topics. In addition, there are many works dealing with the other departments of classical philology, as epigraphy, history of ancient peoples, archaeology, philosophy, history of art, geography, chronology, metric, etc.

The Heyne Library of Germanics.—The entire library of Professor Moritz Heyne of the University of Göttingen was bought in 1909. It contains about 5,200 volumes. The collection is rich in the general field of German philology and especially in lexicography. It has many rare first editions of works of German literature from the sixteenth, seventeenth and eighteenth centuries, and has sets of a number of rare periodicals. It is also rich in works upon the history of German civilization.

The Gröber Library in Romance Languages.—The University has recently purchased the library of Professor Gröber of the University of Strassburg. This library contains about 6,500 titles, and added to what is already in the University library, furnishes somewhat over 10,000 volumes for use in this field.

Furthermore, notable additions have been made in the past few years to the libraries of the departments of history, education, economics, English and political science.

FEES AND EXPENSES

Except as noted below, graduate students pay fees as follows:

Matriculation fee	$10.00
Incidental fee, each semester	12.00
Diploma fee	5.00

All graduate students who have not matriculated as undergraduates at the University of Illinois pay the matriculation fee on entrance.

All graduate students pay the diploma fee on being recommended for their degrees.

No tuition or incidental fee is charged for graduate courses to scholars, fellows, or members of the corps of instruction or the staffs of the scientific bureaus or experiment stations, nor for undergraduate courses on their study lists if approved by the heads of the departments and by the Dean of the School as necessary or desirable for the proper completion of the work for the degree. Otherwise, graduate students who take undergraduate courses must pay the proper undergraduate fee.

Each student working in laboratories, or in the drafting or engineering classes, is required to make a deposit of from 50 cents to $10.00, to pay for chemicals and apparatus used, and for any breakage or damages. But no charges or deposits for laboratory materials are required from scholars, fellows, or members of the corps of instruction or scientific staffs mentioned above.

Table board may be obtained at prices ranging from $4.00 per week.

Room rent, with two in a room, from $2.50 per week.

THE GRADUATE CLUB

The Graduate Club is an organization of the graduate students and graduate faculty. Its purpose is to furnish an opportunity for those working in different departments to become acquainted with one another and thus counteract the tendency toward narrowness which graduate work often develops.

DEPARTMENTS OF INSTRUCTION

Courses are offered in the following groups of subjects:

A. Language and Literature.
B. History and the Social Sciences.
C. Education, Philosophy and Psychology.
D. The Sciences, including Mathematics.
E. Engineering.
F. Agriculture.

A. Language and Literature

THE CLASSICS

The Degree of Master of Arts in Classics.—The major may be in either Latin or Greek, but every candidate for a degree should take work in both languages. For those who have not already had elementary Greek a special course (Greek 21, for graduates and advanced undergraduates) has been provided.

Each candidate must also pass two examinations before the period of the regular course examinations of the second semester, which are to be regarded as tests of attainment, rather than as imposing any requirement of special or additional preparation. The first examination will consist of written translation at sight from the candidate's major language of passages equivalent in difficulty to the translation work of first-year graduate courses. The second examination will be oral and designed to reveal the candidate's general ability and his advancement in the various fields of classical philology, especially those treated in the Classical Proseminary.

The Degree of Doctor of Philosophy in Classics.—The following features of the special departmental requirements for this degree may be noted here: The degree is given in Classical Philology. Major work may be taken in either Latin or Greek, but whichever language is taken as the major, the other must be taken as the first minor.

GREEK

Preparation for first year graduate work in Greek must include two years of college Greek in addition to entrance requirements, and three years of collegiate Latin. A reading knowledge of German or French, preferably the former, is highly desirable for candidates for the Master's degree. The study of History and of Philosophy is especially recommended.

Courses for Graduates

104. HOMER AND THE HOMERIC QUESTION.—Lectures and reading in alternate hours. The whole of the *Iliad* and a large portion of the *Odyssey* will be read. *Twice a week; both semesters.* Associate Professor OLDFATHER. [Alternates with 105].

105. PLATO.—Lectures and reading in alternate hours. Selections from the Republic will be read and interpreted. *Twice a week; both semesters.* Associate Professor OLDFATHER. [Alternates with 104. Not given in 1912-13.]

106. GREEK DRAMA.—One play of each of the great dramatists will be made the basis of a detailed investigation into the origin and development of dramatic technique, and the history of that phase of Greek literature. In addition to the plays read in class certain others will be assigned for private reading. *Twice a week; both semesters.* Professor MOSS.

107. GREEK ORATORY.—One or more speeches of each of several orators will be read rapidly, and the remainder of the year will be spent upon more detailed study of one or two authors, with especial attention to their style, their place in the canon, and their relation to their times. Certain problems in the Athenian constitution and legal practice will be assigned for individual study and reports. *Twice a week; both semesters.* Professor MOSS. [Not given in 1912-13.]

Course for Graduates and Advanced Undergraduates

21. BEGINNING GREEK.—Composition and Grammar; Lec-

tures on Greek Literature. (This course, while open to graduate students, is not credited towards advanced degrees.) *Four times a week; both semesters.* Professor Moss.

LATIN

Students desiring to take first-year graduate work in Latin must have at least three years of college Latin in addition to entrance requirements. A reading knowledge of German or French, preferably the former, is earnestly desired from candidates for the master's degree. Some acquaintance with Greek is indispensable for advanced work in Latin. For those who have not already had elementary Greek a special course (Greek 21, for graduates and advanced undergraduates) has been provided. The study of History and of Philosophy is especially recommended.

Courses for Graduates

103. Cicero.—The *De Natura Deorum* and the *De Divinatione*, The Epicurean, Stoic, and Academic Theories of religion and their relation to the popular worship will be considered. *Twice a week; first semester.* Assistant Professor Pease.

104. Latin Palaeography.—Lectures on the material and form of ancient books, the methods of copying, and the commoner errors in manuscripts. A study of facsimiles of codices of different periods and styles, and practice in the principles of text criticism so far as they are dependent upon palaeography. *Once a week; first semester.*

Assistant Professor Pease.

105. A Survey of Latin Poetry.—Lectures on the history and development of Latin poetry. Typical selections from the principal authors and periods treated will be assigned for outside reading and portions will be interpreted in class. *Twice a week; second semester.* Assistant Professor Pease.

[Not given in 1912-13.]

106. Latin Comedy.—Twelve plays of Plautus and Terence will be read. Lectures on literary history and on syntax. *Twice a week; both semesters.*

Associate Professor Oldfather.

107. Latin Epigraphy.—The purpose of this course is to familiarize the student with the forms and language of inscriptions, and to read selections from those in the *Corpus Inscriptionum Latinarium,* especially of such as are important for their content. A short report may be called for. *Twice a week; second semester.* Assistant Professor Pease.

108. Tacitus.—The *Histories.* The style of Tacitus will be studied in comparison with that of other historians. Particular attention will be devoted to the events of the year 69 A. D., with reference to political and social conditions. *Twice a week; second semester.* Professor Barton.

109. Virgil.—The life and works of Virgil, with study of his sources and of his influence upon later literature. *Twice a week; second semester.* Assistant Professor Pease.

Courses for Graduates and Advanced Undergraduates

14. Seneca.—Selections from his Essays, Letters, and Tragedies. *Three times a week; first semester.*

Professor Barton.

16. Martial and Suetonius.—Selections and lectures. *Three times a week; second semester.*

Associate Professor Oldfather.

Classical Philology

110. Proseminar.—This course is designed to make clear the aims and methods of Classical Philology, to outline the more important divisons of the subject, and to present the main sources of bibliographical material, together with selected bibliographies of certain special fields. Attention is given to the preparation of theses for advanced degrees. All graduate students who are taking Latin or Greek as a major for the master's degree must elect this course unless they already have completed it or its equivalent. *Once a week; both semesters.* Associate Professor Oldfather and Assistant Professor Pease, assisted by the other members of the department.

111. Principles of Comparative Grammar.—A general survey of the principles of linguistic science is followed by a

systematic study of Greek and Latin sounds and inflections. Attention is also given to the historical development of Latin syntax. *Three times a week; first semester.* Dr. CANTER.

[This course may be counted for either Greek or Latin credit.]

ENGLISH

Students who enter upon graduate work with English as their major subject are required to give evidence of ability to write well, and of a considerable acquaintance with English Literature. They should have had training as undergraduates in the classics, the modern languages, history and philosophy.

A reading knowledge of French and German is from the beginning highly desirable; after the first year it is indispensable.

The Degree of Master of Arts in English.—In addition to complying with the general rules of the Graduate School, candidates for the degree of Master of Arts in English must comply with the following rules of the Department of English: (1) they must choose a portion of their work from the group of courses described as "for graduates;" (2) must offer an elementary course in Anglo-Saxon; and (3) must take, besides the regular semester examinations in all their courses, a general examination, oral or written as the department may prescribe, which shall be a final test of the candidate's fitness and ability.

The Degree of Doctor of Philosophy in English.—Candidates for the degree of Doctor of Philosophy in English may expect to be examined on the entire field of the English language and literature. They are urged, furthermore, to acquaint themselves as fully as possible with the history and the philosophy of the period in which their main interest lies, and with the foreign language and literature most closely related to English in that period.

Courses for Graduates

101. RESEARCH IN SPECIAL PERIODS.—Competent graduate students are encouraged to seek the advice and assistance of

the department of English and to submit to the Department plans for study in the language or literature of the periods mentioned below.

A. Anglo-Saxon Language and Literature.
Professor Dodge and Dr. Zeitlin.

B. Thirteenth and Fourteenth Centuries. Dr. Jones

C. Sixteenth Century.
Professor Alden and Professor Dodge.

D. Seventeenth Century.
Professor Alden and Assistant Professor Baldwin.

E. Eighteenth Century.
Professor Sherman and Assistant Professor Paul.

F. Nineteenth Century.
Professor Sherman and Associate Professor Fulton.

102. Seminary in Comparative Literature.—Subject: Tragedy in the Nineteenth Century. *Twice a week; first semester.* Professor Alden.

105. Shakespeare's Sonnets.—A close study of the text and the problems involved in its interpretation. *Twice a week; second semester.* Professor Alden.

106. English Literary Criticism from the Age of Sidney to the Age of Coleridge. *Twice a week; both semesters.* Associate Professor Fulton.

109. German and Scandinavian Influences on English Literature of the Eighteenth and Nineteenth Centuries.—*Twice a week; first semester.* Professor Dodge.

110. Old English (Anglo-Saxon) Poetry.—*Twice a week; both semesters.* Professor Dodge.

113. Historical Prose Syntax.—The forces, native and foreign, at work in the development of English prose style as far as it relates to sentence structure. During 1912-13 the emphasis will be placed on Tudor prose. *Twice a week; both semesters.* Dr. Zeitlin.

126. English Ballads and Metrical Romances.—*Twice a week; both semesters.* Dr. Jones

127. Middle English.—Critical reading of Middle English texts. Dr. Jones

[Not given in 1912-13.]

136. The Transition from the Seventeenth to the

EIGHTEENTH CENTURY; THE RISE OF CLASSICISM.—*Twice a week; both semesters.* Assistant Professor PAUL.

137. NINETEENTH CENTURY PROSE WRITERS.—*Twice a week; both semesters.* Professor SHERMAN.

138. THE ROMANTIC MOVEMENT IN ENGLAND.— Professor SHERMAN.

[Not given in 1912-13.]

150. OLD IRISH.—Selections from the glosses and from the *Tain bo Cualange*; lectures on Old and Middle Irish literature. Dr. SCHOEPPERLE.

[Not given in 1912-12.]

Courses for Graduates and Advanced Undergraduates

A. LITERATURE AND LANGUAGE.

3. THE POETRY OF MILTON.—*Twice a week; second semester.* Assistant Professor BALDWIN.

4. ENGLISH VERSIFICATION.—Theory of English rhythm and metre; history of the development of the forms of English verse. *Three times a week; first semester.* Professor ALDEN.

5. SHAKESPEARE AND HIS PREDECESSORS.—The second semester, devoted to Shakespeare, may be taken without the first. *Three times a week; both semesters.* Professor DODGE.

8. OLD ENGLISH (ANGLO-SAXON).—Grammar; prose; short poems; *Beowulf*. *Three times a week; both semesters.* Professor DODGE.

14. STUDIES IN THE HISTORY OF JOURNALISM.—Dr. SCOTT.

[Not given in 1912-13.]

15. TEACHERS' COURSE.—Methods of teaching English literature and composition in the high school. (This course, while open to graduate students, is not credited toward advanced degrees.) *Twice a week; both semesters.* Assistant Professor PAUL.

18. MODERN ENGLISH GRAMMAR.—The structure of the sentence and its analysis into the parts of speech; the common grammatical categories; the peculiarities of English Syntax. *Three times a week; second semester.* Dr. ZEITLIN.

27. LITERATURE OF THE FOURTEENTH CENTURY.—The chief purpose of this course is to study that literature of the period which best reflects the religious and political life of the time.

Some attention will be given to Chaucer and to the so-called revival of alliterative poetry. *Three times a week; second semester.* Dr. JONES.

35A. ENGLISH DRAMA FROM 1600 TO 1700.—Chapman, Jonson, Dekker, Marston, Heywood, Middleton, Beaumont and Fletcher, Webster, Ford, Massinger, Shirley, Dryden, Wycherly, Otway, Lee, Congreve, Vanbrugh. *Three times a week; first semester.* Professor SHERMAN.

(35B. dealing with the drama from 1700 to 1900, will be omitted in 1912-13.)

38. THE ARTHURIAN TRADITION IN ENGLAND.—Primitive elements; the Historical Arthur; Celtic, French, and Italian influences; the tradition in England from the early romances to Arnold. *Three times a week; second semester.* Dr. SCHOEPPERLE.

39. INTRODUCTION TO THE LITERATURE OF THE MIDDLE AGES.—European culture, from the fourth century; the relations of English and continental literature, to the fourteenth centruy. *Three times a week; second semester.* Dr. CREEK.

B. RHETORIC

15. ADVANCED NEWSPAPER WRITING.—The larger problems in reporting; application of the principles of history, economics, and political science to public events; editing, editorial writing. *Twice a week; both semesters.* Dr. SCOTT.

17. ADVANCED COMPOSITION.—Practice writing, with special emphasis on the study of structure; criticism of current periodical literature; the developing of material for reports, magazine articles, etc. *Three times a week: second semester.* Mr. GUILD.

GERMANIC LANGUAGES

GERMAN

Students desiring to take German as a major are expected to have finished successfully a four years' course of undergraduate work in German, corresponding to the four years,

course in German at this University. They are expected to be familiar with the principal works of the writers of the classical and modern periods of German literature, to show a general knowledge of the history of German literature and to be able to follow lectures in the German language.

Of collateral subjects, a reading knowledge of Latin and French is required. It is desirable that candidates for the degree of Ph. D. have some knowledge of Greek. All students are expected to have had a course in German History.

Courses for Graduates

101. SEMINAR IN GERMANIC PHILOLOGY.—The work is adapted to the abilities and tendencies of the students. The primary object is to give training in original research. The result of the work, when of value, may be published in the *Journal of English and Germanic Philology. Once a week; both semesters.* Professor GOEBEL.

103. INTRODUCTION TO THE HISTORICAL STUDY OF THE GERMANIC LANGUAGES.—Lectures; discussions of special topics History of German Philology. Comparative Grammar of the Old Germanic dialects. *Twice a week; second semester.*

[Not given in 1912-13.] Professor GOEBEL.

104. GOTHIC.—An introductory study of its grammar and literature. *Twice a week; first semester.* Professor GOEBEL.

105. OLD HIGH GERMAN.—Grammar and interpretation of the oldest literary documents, *Three times a week; second semester.* Dr. BLOOMFIELD.

109. GOETHE'S AND SCHILLER'S PHILOSOPHY.—*Twice a week; both semesters.* Professor GOEBEL.

110. EARLY GERMAN DRAMA.—The development of the German drama up to the Reformation, including the medieval religious drama, the Shrovetide plays and the beginnings of the Humanistic drama. *Twice a week; first semester.*

Assistant Professor BROOKS.

113. GERMAN LITERATURE OF THE FIFTEENTH AND SIXTEENTH CENTURIES.—Survey of the literature on the back-ground of the general history of the time. Luther and the Reformation, Mastersingers and Folksong, the Reformation drama,

Hans Sachs, Brant, Fischart, the chap books, the English comedians. *Twice a week; second semester.*

Assistant Professor BROOKS.

115. HISTORY OF GERMAN LITERATURE FROM GOETHE'S DEATH TO THE PRESENT TIME. *Twice a week; both semesters.*

Associate Professor LESSING.

116. MEDIEVAL GERMAN LITERATURE WITH REFERENCE TO THE POLITICAL, RELIGIOUS, AND SOCIAL HISTORY.—Research course. *Twice a week; both semesters.*

Associate Professor LESSING.

117. HISTORY OF GERMAN LITERATURE DURING THE EIGHTEENTH CENTURY.—I. Professor GOEBEL.

[Not given in 1912-13.]

118. THE GERMAN DRAMA SINCE SCHILLER.—Research course. *Twice a week; both semesters.*

Associate Professor LESSING.

[Not given in 1912-13.]

119. THE GERMAN NOVEL.—Research course. *Twice a week; both semesters.* Associate Professor LESSING.

[Not given 1912-13.]

121a. THE NIBELUNGENLIED.—Lectures and interpretations. *Twice a week; second semester.* Professor GOEBEL.

124. HISTORY OF THE DRAMA.—The beginnings of the drama and its development in the eighteenth century. *Twice a week; first semester.* Assistant Professor MEYER.

[Not given in 1912-13.]

Courses for Graduates and Advanced Undergraduates

8. SCHILLER.—The life of Schiller; *Wallenstein* and other selections. *Three times a week; first semester.*

Associate Professor LESSING.

9a. GOETHE'S FAUST.—The Faust legend and early Faust books and plays; the genesis of Goethe's *Faust*; reading of both parts. *Twice a week; both semesters.* Professor GOEBEL.

[Not given 1912-13.]

9b. GOETHE-SCHILLER.—Interpretation of Goethe's poems. Goethe's *Tasso* and Schiller's *Ueber naive und sentimentalische Dichtung*. *Twice a week; both semesters.*

Professor GOEBEL.

11. German Literature after the Reformation.—Lectures; recitations; reports on assigned reading. *Three times a week; second semester.* Associate Professor Lessing.

25. Teacher's Course.—Discussion of methods; examination of text-books. *Twice a week; second semester.* Assistant Professor Brooks.

26. German Literature before the Reformation.—Lectures; recitations; reports on assigned reading. *Three times a week; first semester.* Associate Professor Lessing.

27. Lessing.—The life of Lessing; *Nathan der Weise, Emilia Galotti* and other selections. *Three times a week; second semester.* Associate Professor Lessing.

29. Advanced Prose Composition.—Themes on Germany and German life, based on suitable reading, discussed in German. *Three times a week; both semesters.* Dr. Koller.

The Scandinavian Languages

Preparation for graduate work in Scandinavian philology must include a general introduction to Germanic philology, such as is contained in a course in Gothic and Old English. However, a student who has, through systematic work, attained a high degree of efficiency in one of the modern Scandinavian languages may pass on to graduate work in Scandinavian Philology with the introductory work in Germanic philology. Preparation for graduate work in literature must include a thorough reading knowledge of one of the Scandinavian languages and systematic work in the undergraduate courses in Scandinavian or the equivalent of these in other colleges.

Courses for Graduates

101. Old Norse.—Introduction to the language as a member of the Germanic group. Kahle's Altislændisches Elementarbuch and Holthausen's Lesebuch will be followed by the reading of the Prose Edda and the Gunnlaugs saga. *Twice a week; both semesters.* Assistant Professor Flom.

102. Old Danish.—Introduction to the language. Read-

ing of the oldest texts and lectures on the history of the Danish language. *Twice a week; first semester.*

Assistant Professor FLOM.

[Not given in 1912-13.]

103. OLD SWEDISH.—Introduction to the language. Noreen's Altschwedische Grammatik and Lesebuch will be used. *Twice a week; second semester.* Assistant Professor FLOM.

110. ADVANCED OLD NORSE.—A critical study of the mythical lays of the Elder Edda with selections from the non-Eddic poetry. *Twice a week; first semester.*

Assistant Professor FLOM.

120. OLD NORSE PALAEOGRAPHY.—The course will be based on the material offered in the "Paleografisk Atlas" and the collection of reproductions of Old Scandinavian manuscripts in the library of the University of Illinois. *Once a week; second semester.* Assistant Professor FLOM.

130. THE RUNIC INSCRIPTIONS.—Lectures on the runes and interpretation of the Germanic and Scandinavian inscriptions; Germanic grammar. *Twice a week; first semester.*

Assistant Professor FLOM.

[Not given in 1912-13.]

150. RESEARCH.—For competent graduate students who wish to undertake the investigation of some special problem in Scandinavian language or literature.

Assistant Professor FLOM.

Course for Graduates and Advanced Undergraduates

11. SURVEY OF THE HISTORY OF THE SWEDISH LANGUAGE AND LITERATURE.—Lectures. [Not given in 1912-13.]

Assistant Professor FLOM.

ROMANCE LANGUAGES

Before entering upon the study of Romance Languages for an advanced degree, the candidate must have had a total of at least thirty hours of college work in these languages. Eighteen of these hours must be in one of the three languages, French, Italian, or Spanish, but no candidate will be received who has not had at least twelve hours of French. In addition a candidate must have had good training in Latin, and be able to read ordinary German prose.

French

Courses for Graduates

102. Old French Readings.—First semester: Chrétien de Troyes and the court epic. Second semester: Readings from Marie de France, the prose chroniclers and the dramatists of the middle ages. *Twice a week; both semesters.*

Professor Oliver.

108. Vulgar Latin and Medieval Latin.—The development of the Latin language, spoken and written, from the earliest times to the Carolingian epoch. This course is conducted in French. *Twice a week; first semester.*

Assistant Professor Beck.

109. History of French Literature in the Middle Ages, from the Ninth to the Fourteenth Century.—This course is conducted in French. *Twice a week; second semester.*

Assistant Professor Beck.

110. Old Provencal.—The language and literature. *Twice a week; both semesters.* This course is conducted in French. Assistant Professor Beck.

[Not given in 1912-13.]

113. Introduction to Romance Philology.—Morphology. *Twice a week; first semester.* Assistant Professor Fitz-Gerald.

115. French Literary Criticism.—After an introduction treating of the history of criticism in antiquity and in the Italian Renaissance, the work of the principal French critics is studied. Special emphasis is laid upon the seventeenth and nineteenth centuries, in connection with the development of classicism and romanticism. *Once a week; both semesters.*

Dr. Blondheim.

125. Seminar.—Research work in the field of Old French literature. *Twice a week; both semesters.*

Associate Professor Carnahan.

Courses for Graduates and Advanced Undergraduates

10. General Survey of French Literature.—An introduction to more extended study of special periods and authors. The main currents of French literature from the beginning to the present time. *Three times a week; both semesters.*

Associate Professor Carnahan.

23. Modern Poetry.—Lectures; declamation; interpretation; outside reading. This course is conducted in French. *Three times a week; both semesters.*

Assistant Professor Beck.

24. French Literature of the Seventeenth and Eighteenth Centuries.—A study of the greater masterpieces of the seventeenth and eighteenth centuries in France. *Three times a week; both semesters.* Professor Oliver.

Spanish

Course for Graduates

121. Oldest Monuments of the Spanish Language.—Historical Grammar and Palaeography. *Twice a week; second semester.* Assistant Professor Fitz-Gerald.

[Not given in 1912-13]

Courses for Graduates and Advanced Undergraduates

11. The Spanish Drama of the Sixteenth and Seventeenth Centuries.—*Encina, Torres Naharro, Lope de Vega, Lope de Rueda, Tirso de Molina, Calderon, Ruiz de Alarcon, Moreto, Rojas Zorilla; Schack's Dramatic Literature. Twice a week; both semesters.* [Not given in 1912-13.] Dr. Seymour.

12. The Novela of the Golden Age.—A study of the political and social conditions in Spain from 1560 to 1700 is followed by an examination of the various kinds of prose fiction produced in this period, with special attention to *Don Quijote* and the *Novelas Ejemplares* of Cervantes. *Three times a week; both semesters.*

Assistant Professor Fitz-Gerald.

15. General Survey of Spanish Literature.—An introduction to more extended study of special periods and authors. *Twice a week; second semester.* Dr. Seymour.

Italian

Course for Graduates and Advanced Undergraduates

2. Literary Course.—First semester: Rapid reading from the works of the principal Italian writers of the nineteenth

century. Second semester: Dante. The *Vita Nuova* and the *Inferno*. Selected stories from Boccaccio's *Decameron*. *Twice a week; both semesters.* Dr. JONES.

B. History and the Social Sciences

ECONOMICS

Every student entering upon graduate work in economics must have had a thorough course in the principles of the science and should also have studied some special part of the field of economics, such as public finance or money and banking.

Graduate students who are making economics their major are required to elect course 101 during their first year of work. In the second or third year they will be expected to elect courses 105 and 120, and some fundamental course in political science and sociology, (either course 11 or 102 in sociology, and political science 101 and 102,) unless they have already had such courses.

The department of economics includes economic theory, economic history, finance, commerce, and industry.

Complete sets of all the important French, German, Italian, English, and American economic and financial journals, are in the library, as well as a number in other languages; more than ninety periodicals, foreign and domestic, in economics, finance, commerce, industry, statistics, etc., are currently received. The library is unusually strong in railroad literature, economic history, labor, finance and general theory.

Courses for Graduates

101. ECONOMIC THEORY.—This is a survey of the field of general economic theory, with emphasis on theories of distribution and their relation to the ethical, philosophical and political views of this and other periods. The course must be taken in the first year of graduate work by all students who have not had its equivalent. *Twice a week; both semesters.* Professor KINLEY.

102. Advanced General Economics.—A survey of the whole field as presented in the works of such writers as Marshall, Pierson, Philippovich. *Twice a week; both semesters.* Professor Kinley.

[Not given in 1912-1913.]

103. Railway Administration.—Topics relating to current railway management are assigned for investigation, report and discussion. The course is primarily intended for candidates for the degree of A. M. in Railway Administration. *Once a week; both semesters.* Professor Dewsnup.

104. Foreign and Colonial Trade of the United States.—A detailed study of the foreign commerce of the United States based upon the use of governmental publications. *Twice a week; second semester.*

Assistant Professor Litman.

105. Public Finance.—The history and theory of public revenue and expenditure. *Twice a week; both semesters,*

Associate Professor Bogart.

[Not given in 1912-1913.]

106. Railway Policy.—A: History of railway development in the United States. B: History of railway development in foreign countries, particularly in western Europe. C: The State and the Railway.

The cycle of topics requires three years for the completion of the course. The topic in 1912-1913 is C. *Once a week; both semesters.* Professor Dewsnup.

107. The Corporation in Economic Evolution.—*Once a week; both semesters.* Professor Robinson.

109. Theory of Industrial Consolidations.—The nature of industrial consolidations; the conditions and causes responsible for their development and their effects upon the production and distribution of wealth. *Once a week; both semesters.*

[Not given in 1912-1913.] Professor Robinson.

118. Seminar.—The subject of study for 1912-1913 will be the economic history of Illinois as a typical Mississippi Valley State. Members of the Staff.

120. History of Economic Thought.—*Twice a week; first semester.* [Not given in 1912-1913.] Dr. Thompson.

122. Advanced Economic History of the United States.—*Twice a week; both semesters.*

Associate Professor Bogart.

Theory of Statistics.—See Mathematics 129.

Courses for Graduates and Advanced Undergraduates

4a. Financial History of the United States to the Civil War.—A study of Colonial and Federal finance, including currency, banking, tariff and fiscal questions. *Twice a week; second semester.* Assistant Professor Weston.

[Not given 1912-1913.]

40b. Financial History of the United States since 1860.—A study of the finances of the Civil War and reconstruction period, and of the recent development of both public and private finance, with special reference to business conditions. *Twice a week; second semester.*

Assistant Professor Weston.

5. Public Finance.—Public debts, revenue, taxation, etc. *Three times a week; first semester.*

Associate Professor Bogart.

8. The Money Market.—An advanced study of dealings in money, credit, foreign exchange, crises, etc. *Twice a week; second semester.* Assistant Professor Weston.

10. Corporation Management and Finance.—*Three times a week; first semester.* Professor Robinson.

11. Industrial Consolidation.—The development of industrial consolidations; plans for controlling trusts; etc. *Three times a week; second semester.*

Professor Robinson.

12. The Labor Problem.—*Three times a week; first semester.* Assistant Professor Litman.

13. Economic Development of Europe Since the Industrial Revolution.—*Three times a week; second semester.*

Associate Professor Bogart.

17. Economic History of Agriculture.—General characteristics of agriculture, and its development as an industry in various countries at various times. State of the agricultural class. Relation of agriculture to other industries. Re-

lation of the state to agriculture. *Twice a week; second semester.* Dr. THOMPSON.

21. SOCALISM AND SOCIAL REFORM.—*Three times a week; second semester.* Assistant Professor LITMAN.

29. FOREIGN COMMERCE AND COMMERCIAL POLITICS. A study of the various commercial systems, mercantile, free trade and protective, etc. *Three times a week; first semester.* Assistant Professor LITMAN.

[Not given in 1912-13.]

30. TARIFF AND CUSTOMS REGULATIONS OF THE UNITED STATES.—*Three times a week; second semester.* Assistant Professer LITMAN.

[Not given in 1912-13.]

41. RAILWAY TRANSPORTATION.—A study of the more general aspects of railway transportation in the United States, with references to conditions abroad. *Three times a week; first semester.* Professor DEWSNUP.

42. RAILWAY RATES, THEIR CONSTRUCTION AND REGULATION.—A somewhat detailed study of the rate structure of the United States, followed by a discussion of rate theory and the policy of the Interstate Commerce Commission. *Three times a week; second semester.* Professor DEWSNUP.

43. THE THEORY AND PRACTICE OF RAILWAY ADMINISTRATION.—A description of the organization and methods of traffic management and a discussion of the problems connected therewith. *Twice a week; both semesters.* Professor DEWSNUP.

45. RAILWAY OPERATION.—A study of the organization, methods of management, and associated problems of the operating department of the railroad. *Twice a week; both semesters.* Professor DEWSNUP.

ACCOUNTANCY

Courses for Graduates and Advanced Undergraduates

4. ADVANCED ACCOUNTING.—This course includes the consideration of the handling of capital, revenue, dissolution of

partnership, realization, liquidation, insolvency, good-will, treatment of bad debts, suspense, maintenance, depreciation, reserve, and sinking funds, contingent funds, secret reserves and the like. *Three times a week; second semester.*

Assistant Professor DUNCAN.

5. AUDITING.—Discussion of the duties and responsibilities of an auditor. the kinds of audits that can be made, the value of each, the auditor's report, what it should contain, his certificate, its value, the preparation of audit reports. *Twice a week; second semester.* Assistant Professor DUNCAN.

6. RAILROAD ACCOUNTING.—The handling of railroad revenue accounts, including freight, passenger, express and other earnings from the road and allied companies, the treatment of operating expenses, fixed charges, the work of the Interstate Commerce Commission in standardizing railway accounting methods. *Twice a week; first semester.*

Assistant Professor DUNCAN.

7. ADVANCED ACCOUNTING PROBLEMS.—This course is a continuation of Accountancy 4. It includes the working out of practical problems involving the application of accounting theory. In this course are also briefly considered the special topics of executor accounts, insurance accounts and accounting for municipalities and other public bodies. *Three times a week; first semester.* Assistant Professor DUNCAN,

HISTORY

Advanced courses in history at the University of Illinois are of three kinds; 1. Instruction in methodology, historiography, and bibliography. This work (in course 103) is required of all graduate students in history during their first year. 2. Seminary courses for the study of special fields with a view primarily to training in the methods of historical criticism and research. 3. Courses for information and guidance in general reading.

Research work is offered in the following fields: Medieval history, English history with emphasis upon medieval institutions; modern European history with special reference to the rise of Prussia and the revolutionary and the Napoleonic era; American history with special reference to institutions,

colonial society, western development, and the period 1820-65; the history of Latin America.

A student entering upon graduate work should have had at least the equivalent of the introductory college courses in English, Continental European, and American history. All historical students should have a reading knowledge of German and French; for medieval history some knowledge of Latin is indispensable, and in certain fields of American history Spanish is needed.

Attention is called to the fact that the University of Illinois has for some time cooperated with the Illinois State Historical Society and the trustees of the State Historical Library, in the gathering and editing of archive material. As a result of this relation instructors and graduate students in the department have contributed from time to time, to the publications of these state organizations and have been given useful training in the study of manuscript as well as printed material.

The Historical Club, consisting of instructors and graduate students in the department, meets once a month. The program is devoted to reviews of current progress in historical work and the results of the investigations of the members.

Illinois Survey.—Historical students also have an opportunity to pursue research in western history in connection with the Illinois Survey.

The Illinois Survey is the name given to work which has been carried on at the University for several years in the study of the the State of Illinois as a typical Mississippi Valley state. The purpose is to write up the history of the state from all points of view. Therefore various departments are engaged in the work. A great deal of material has been gathered and considerable work done in the history of the state, so that there is abundant research material for students interested in this field.

Courses for Graduates

101. Seminar in American History.—The work of this course consists partly of general exercises in which all the members of the class are expected to take part. In these exercises

some attention is given to the general bibliography of American history; but a large part of the time is devoted to the cooperative study of typical problems. *Two hours, once a week; both semesters.*

Professor GREENE, Associate Professor ALVORD, Dr. BUCK.

102. STUDIES IN ENGLISH HISTORY.—*Twice a week; both semesters.* Assistant Professor LARSON.

103. HISTORICAL BIBLIOGRAPHY AND CRITICISM.—Selected problems in various fields, Required of all candidates for an advanced degree in history who do not present evidence of similar training elsewhere. *Twice a week; both semesters.* Professor FORD and others.

104. SEMINARY IN MODERN EUROPEAN HISTORY.—The subject selected for 1912-13 is the diplomatic relations between France and Prussia in the period of the French Revolution. *Both semesters.* Professor FORD.

105. THE HISTORY OF WESTERN EXPANSION, 1763-1818.—The period indicated is covered by lectures and readings, but the main object of the course is the study of various problems in the interpretation of western history. *Once a week; both semesters.* Associate Professor ALVORD.

111. SPANISH-AMERICAN RELATIONS.—The relations of the Latin-American states with Europe and the United States. An intensive study of such topics as the Monroe Doctrine, the development of international trade, etc. A reading knowledge of either French or Spanish is expected. *Once a week; both semesters.* Assistant Professor ROBERTSON.

Courses for Graduates and Advanced Undergraduates

4. CONSTITUTIONAL HISTORY OF ENGLAND.—During the first semester the emphasis is placed on institutional origins; in the second semester particular attention is given to modern constitutional practice. *Three times a week; both semesters.* Assistant Professor LARSON.

8. MEDIEVAL CIVILIZATION.—This course traces the religious, economic and intellectual development of medieval society. Emphasis is placed on social changes and the growth of culture in England, and the materials for study are sought largely in the English sources. Attention is also given to

corresponding movements on the continent. *Twice a week; first semester.* Assistant Professor LARSON.

9. THE ERA OF THE RENAISSANCE.—This course deals with the political, religious, and economic history of Europe during the fourteenth and fifteenth centuries as well as the intellectual and artistic revival. It is designed to be a continuation of course 8, although either may be taken separately. *Twice a week; second semester.* Assistant Professor LARSON.

10. AMERICAN SOCIETY ON THE EVE OF THE REVOLUTION.—*Three times a week; second semester.* Professor FORD.

12. HISTORY OF GERMANY.—Special attention will be paid to the settlement and the eastern expansion, the development of German cities, the Reformation aud the rise and development of Brandenburg-Prussia since 1640. *Twice a week; both semesters.* Professor FORD.

13. AMERICAN REVOLUTION, 1760-1783.—The following topics are considered: The American people and their institutions at the close of the colonial era; the causes of the Revolution, 1760-1775; a survey of the war period, 1775-1783. with emphasis on the economic, social, and political changes, rather than upon military and diplomatic transactions. *Twice a week; first semester.* Professor GREENE.

[Not given in 1912-13].

14. THE MAKING OF THE FEDERAL CONSTITUTION.—This course provides for an intensive study, based upon original material, of the events from 1783-1789 which resulted in the framing and ratification of the federal convention of 1787, and of the contemporary arguments for and against the ratification of the Constitution. *Twice aweek; first semester.* Professor GREENE.

[Not given in 1912-13].

15. AMERICAN HISTORY, 1820-1865.—Expansion, slavery, sectionalism, and the Civil War. *Twice a week; second semester.* Dr. COLE.

16. THE HISTORY OF THE EXPLORATION AND COLONIZATION OF THE WEST FROM THE EARLIEST TIMES TO 1818.—The struggle of France, Great Britain, Spain, and the United States for the possession of the West. Special attention is given to the colonial policy followed by each nation. *Twice a week; first semester.* Associate Professor ALVORD.

17. The History of Illinois from 1818 to 1870.—This course is in a measure a continuation of History 16, and the subject is treated not from a purely local point of view, but as an illustration of the development of a typical commonwealth in the Middle West. *Twice a week; second semester.*

Associate Professor Alvord.

21. The History of the United States Since the Civil War.—Historical introduction to contemporary American politics. *Twice a week; first semester.*

Assistant Professor Robertson.

26. The History of the Latin-American Colonies.—The political, economic, social, and intellectual life of Spain during the period of discovery. The exploration, settlement and civilization of Spanish America and the Philippines. Some attention is also given to the exploration and colonization of Brazil. *Twice a week; first semester.*

Assistant Professor Robertson.

27. History of Latin-America from the War of Independence to the Present Time.—The national history of the leading Latin-American states with special attention to political parties, existing governments, and the relations with Europe and the United States. A study of the old regime in Texas, Mexico and California. *Twice a week; second semester.*

Assistant Professor Robertson.

POLITICAL SCIENCE

Graduate work in political science is conducted in the following special fields: (1) Political Theory; (2) International Law and Diplomacy; (3) Comparative Government; (4) Constitutional Law; (5) Administrative Law; (6) Public Administration.

No student is considered qualified to carry graduate work in political science who has not had at least the equivalent of the introductory college course in government and history. A reading knowledge of German and French is highly desirable, and in some of the courses is indispensable.

Several courses given by other departments may be accepted as part of the major work in political science. These include: History 4 (English Constitutional History), History

14 (Making of the Federal Constitution), History 27 (History of Latin America), History 106 (Spanish American Relations), Economics 5 (Public Finance), Economics 30 (Tariff and Customs Regulations), Sociology 6 (Problems of Urban Communities), Sociology 9 (Criminology), Law 24 (Municipal Corporations).

Courses for Graduates

101. History of Political Theories.—Professor Garner. [Not given in 1912-13].

102. The Nature of the State.—The principles, methods and relations of political service; the origin, nature, forms and functions of the state; sovereignty and liberty; citizenship and nationality; constitutions; principles of political organization. *Twice a week; first semester.*

Professor Garner.

103. Seminar in Political Science and Public Law.—*Once a week; both semesters.* Members of the Department.

104. Municipal Administration.—Studies in municipal organization and functions in the United States and Europe; the relations between city and state, local organization, political methods and reform movements, police and health administration, public works, municipal ownership and public regulation of public utilities, municipal finances. The particular topics considered differ from year to year. *Three times a week; second semester.* Professor Fairlie.

105. Special Topics in Constitutional Law of the United States.—For 1912-13 the subject for discussion is that of judicial power over legislation. *Twice a week; second semester.* Assistant Professor Dodd.

Courses for Graduates and Advanced Undergraduates

4 Municipal Government.—The growth of cities; municipal home rule; municipal organization and functions in the United States; the mayor and council; commission government; police, light and water supply; city planning; urban transportation; municipal ownership and regulation of public utilities. *Three times a week; first semester.*

Professor Fairlie.

5. CONSTITUTIONAL LAW OF THE UNITED STATES.—*Four times a week; first semester.* Assistant Professor DODD.

6. INTERNATIONAL LAW.—*Three times a week; first semester.* Professor GARNER.

7. AMERICAN DIPLOMACY.—A study of genesis and present organization of the Department of State; the diplomatic service; the treaty making power; the methods and traditional principles of the foreign policy of the United States; historical review of the principal diplomatic controversies between the United States and foreign powers from the foundation of the government to the present time; the rise of the United States to the position of a world power. *Twice a week; second semester.* Dr. MATHEWS.

[Not given in 1912-13.]

9. PRINCIPLES OF JURISPRUDENCE.—The nature of law; historical development of Roman and English legal systems; English common law in the United States; sources of law and relation between statutes and judicial decisions; brief discussions of the various branches of law (crime, tort, contract, etc.) and their relation to one another. *Three times a week; first semester.* Assistant Professor DODD.

10. ADMINISTRATIVE LAW IN THE UNITED STATES.—Separation of governmental powers and delegation of legislative power; federal and state administrative organs; methods of enforcing governmental commands; remedies of the individual against unlawful action by public officers. *Three times a week; second semester.* Assistant Professor DODD

11. CONSTITUTIONAL ASPECTS OF SOCIAL AND INDUSTRIAL PROBLEMS.—The police; constitutional limitations upon legislation concerning the public health and safety; the control of public service corporations and combinations of capital and labor. *Three times a week; second semester.* Assistant Professor DODD.

12. NATIONAL ADMINISTRATION IN THE UNITED STATES.—A study of the President and his Cabinet; the executive departments and the administrative services of the national government, etc. *Three times a week; second semester.* Professor FAIRLIE.

13. STATE ADMINISTRATION IN THE UNITED STATES.—The administrative position of the governor, and the organization

of the state administrative departments. Organization and powers of state boards, commissions and quasi-judicial tribunals. Tendencies towards centralization in state functions. Methods of control over state administrative officers. *Three times a week; first semester.* Dr Mathews.

14. Political Parties.—A study of the development of political parties and their organization and influence on the government mainly in Great Britain and the United States, with attention to recent legislation in primaries and nomination methods in this country. *Twice a week; first semester.* Professor Fairlie.

18. World Politics.—The main currents of international politics in Europe since the Treaty of Berlin. The colonial expansion of the United States since the Spanish War, and the present position of the United States as a world power. *Three times a week; second semester.* Dr. Mathews

21. British Government.—Political Institutions in the United Kingdom and the British Possessions. *Three times r week; first semester.* Professor Fairlie.

22. Continental European Government.—A comparative study of the national political systems of France, Germany, Italy, Austria-Hungary and Switzerland. *Three time a week; second semester.* Professor Garner.

28. Problems of Contemporary Politics.—The initiative and the referendum; proportional representation; state socialism; universal suffrage; electoral reform; local self-government; judicial reform; parliamentary government; the Monroe Doctrine, etc. *Twice a week; second semester.* Professor Garner.

30. The Law of Taxation.—[Not given in 1912-13.]

SOCIOLOGY

Graduate work in sociology presupposes training in the social sciences, at least in economics and history, and also in psychology. Candidates for the doctor's degree with sociology as the major subject, will be expected to have taken some fundamental course in economics and in political science, such as economics 101 or 122, and political science 102.

The graduate courses in this department are of two classes: Those of the first class deal with the principles of general sociology; these principles relate to the essential nature, methods of evolution, and types of determining causes, of customs, institutions, and the other social forms whether they serve economic, political or other purposes. The courses of the second class treat, in the light of the principles of general sociology, those practical social problems which lie outside the range of economics and politics.

The library has most of the standard works in general sociology by American, English, and European authorities, a collection of books on various sociological problems, and an excellent list of periodicals. Special attention is given to ethnographic and anthropologic materials.

Courses for Graduates

101. Sociological Method.—The method of advancing the science of sociology; adaptability to sociological investigation of certain methods described in Pearson's Grammar of Science, Wundt's Methodenlehre, zweite abtheilung, Seignobos' La Méthode Historique Appliquée aux Sciences Sociales, Bernheim's Historische Methode, Spencer's Study of Sociology, and Giddings' Inductive Sociology. *Three times a week; first semester.* Professor Hayes.

102. The Development of Sociology.—A reading course in the works of writers who have contributed most to the development of sociology, with discussions and supplementary lectures. The course is arranged in a cycle of three years, the first year devoted to authors whose works can be read in English, the second to German authors, the third mainly to French writers. In 1912-13 the second year of this cycle will will be given. *One session, two hours, each week; both semesters.* Professor Hayes.

150. Seminar.—*One session of two hours each week; both semesters.* Professor Hayes.

Courses for Graduates and Advanced Undergraduates

3. Social Evolution.—A course for students who desire acquaintance with the comparative method of dealing with

questions of theory in the social sciences, presenting a large body of facts concerning the various forms of social activity, mainly in their more primitive stages as shown by savage and barbarous peoples, with inductions from such facts concerning the theory of social evolution and the method of progress. *Three times a week; second semester.* Professor HAYES.

6. THE SOCIAL PROBLEMS OF THE URBAN COMMUNITY.—*Three times a week; second semester.* Professor HAYES.

[Not given in 1912-13.]

8. GENERAL CHARITIES.—Brief study of the evolution of modern organized philanthropy, public, and private; causes and prevention of poverty; organization and management of charitable institutions. *Three times a week; first semester.* Dr. TODD.

9. CRIMINOLOGY.—Nature, causes, and treatment of the criminal; evolution of modern methods of criminal procedure and penology; recent experiments and tendencies. *Three times a week; second semester.* Dr. TODD.

10. POPULATION.—Theories and policies of population; Malthus' "Principle" and its critics; problems in population of United States; immigration, race mixture, conditions affecting public health, death-rate, birth-rate, "race-suicide", marriage, divorce, etc.; selective influences at work on the "Population type". *Three times a week; first semester.* Dr. TODD.

11. PRINCIPLES OF SOCIOLOGY.—Fundamental principles and main teachings of sociology, derived from a minute analysis and classification of the elements that make up the life of a people, types of change to which they are subject, and causes by which they are affected. *Three times a week; first semester.* Professor HAYES.

15. THE FAMILY.—Evolution of the family and marriage; educational, moral, and political significance of the family at different stages of social development. *Twice v week; both semesters.* Dr. TODD.

[Not given in 1912-13.]

26. SOCIAL EDUCATION.—Education as a factor in social progress. Present day education policy and organization in the light of theoretical and applied sociology. *Three times a week; second semester.* Dr. TODD.

12. The Labor Problem.—The same as Economics 12.

22. Socialism and Social Reform.—The same as Economics 21.

C. Education, Philosophy and Psychology

EDUCATION

Students who elect education as a major subject must have completed at least a three hour course in the Principles of Education, a similar course in the History of Education, and at least three hours in Psychology and three in Philosophy. For graduate students who have had experience in teaching, these requirements may be modified.

Courses for Graduates

101. Seminar.—*Once a week; first semester.* Professor Bagley, Professor Coffman, Assistant Professor Anderson.

111. Practice Teaching.—[Not given in 1912-13.]

112. Principles of Education.—The organization of public education in the United States and other countries, the aims of education; a brief resumé of the principles of teaching. This course is designed for the general student and may be taken for credit only by students who have not elected education as a major subject. *Twice a week; second semester.*
Professor_____

108. History of Industrial and Vocational Education.—Industry and industrial training in Egypt, Greece, Rome; industry and industrial training in the Middle Ages; the industrial revolution and its effect upon education; recent tendencies in the development of agricultural and industrial high schools, agricultural colleges, monotechnic schools, continuation schools, etc. *Twice a week; second semester.*
Assistant Professor Anderson.

119. The Elementary Curriculum.—The functions and values of the elementary school subjects; practical exercises in the construction of school curricula. (Designed especially for superintendents and principals.) *Three times a week; first semester.* Professor_____

Courses for Graduates and Advanced Undergraduates

4. Problems of Educational Administration.—The interpretation of present tendencies as exemplified in the school systems of typical cities and states, and in recent educational experiments in administration, discipline, methods, and subject-matter. *Three times a week; first semester.*

Professor Coffman.

5. Comparative Education.—Elementary and secondary education in the United States, England, Germany, and France. *Three times a week; first semester.*

Assistant Professor Anderson.

6. Principles of Secondary Education.—High School organization and management; educational value of subjects represented in the secondary curriculum; the structure of the course of study; the technique of secondary teaching and management. *Three times a week; second semester.*

Professor Coffman, and Assistant Professor Hollister.

12. History of Secondary Education.—The development of the secondary school in Europe and in America. *Twice a week; second semester.* Assistant Professor Anderson.

13a. Educational Classics.—The sources of the history of education; the educational writings of Plato, Aristotle, Quintilian, Montaigne, Milton, Locke, Rousseau. *Three times a week; first semester.* Assistant Professor Anderson.

13b. Educational Classics.—(A continuation of Course 13a.) The educational theories of Pestalozzi, Herbart, Froebel, Herbert Spencer, and others. *Three times a week; second semester.* Assistant Professor Anderson.

18. Principles of Esthetic, Moral, and Religious Education.—*Three times a week; first semester.*

[Not given in 1912-13.]

20a. Theory of Supervision.—The problems of supervision; the supervisor's function in training and improving teachers. (Open only to graduate students and to seniors who are either graduates of normal schools or experienced teachers, or who are preparing for the work of supervision in special subjects, such as household science, manual training, and physical training.) *Three times a week; second semester.*

Professor Coffman.

20b. Theory and Practice of School Supervision.—[Not given in 1913-13.]

25. Educational Psychology.—(See Psychology 11.) Professor Bagley.

PHILOSOPHY

Every student entering upon graduate work in philosophy must have had a thorough general course in the history of philosophy and a course in logic. A general course in psychology is also required.

Courses for Graduates

101. The Philosophy of Plato and Aristotle.—*Twice a week; both semesters.* Professor Daniels.

[Not given in 1912-1913.]

102. Seminar.—Contemporary Philosophy. A study of present day idealism, realism, and pragmatism. *Twice a week; both semesters.* Professor Bode.

103. Seminar.—Ethical theory. *Once a week; second semester.* Professor Daniels.

104. The Philosophy of Descartes, Spinoza and Leibniz.—*Twice a week; first semester.* Professor Daniels.

105. The Philosophy of Schopenhauer and Lotze.—*Twice a week; second semester.* Professor Daniels.

Courses for Graduates and Advanced Undergraduates

5. Political Philosophy.—Philosophical theories of the state, historical, critical and constructive. *Twice a week; first semester.* Professor Daniels.

[Not given in 1912-1913.]

7. Ethics.—The beginnings and growth of morality; analysis and criticism of the leading conceptions of moral theory; discussion of some of the typical social and economic problems of the present. *Three times a week; second semester.* Professor Daniels.

11. Philosophy of Religion.—The philosophical interpretations of religious consciousness and a critical study of

various religious concepts; God, revelation, inspiration, dogma, faith, prayer, immortality, the problem of evil, the relation of morality and religion. *Twice a week; second semester.*

[Not given in 1912-1913.] Professor DANIELS.

15. THE BRITISH PHILOSOPHERS OF THE EIGHTEENTH CENTURY.—Locke, Berkeley and Hume. *Three times a week; first semester.* Professor BODE.

AMERICAN PHILOSOPHY.—*Twice a week; second semester.* Professor BODE.

PSYCHOLOGY

No student may do graduate work in psychology without having had courses in elementary psychology, and at least one three-hour course in philosophy.

Courses for Graduates

101. RESEARCH.—Opportunity to investigate advanced problems in experimental psychology, and in comparative and genetic psychology is offered to properly qualified graduate students. *Both semesters.*

102. CONTEMPORARY LITERATURE.—The most imporant problems of contemporary psychology, with their historical bearings, will be presented and discussed. *Once a week; both semesters.* Assistant Professor ARPS.

111. THE PSYCHOLOGY OF THE INTELLECTUAL PROCESSES.—*Once a week; second semester.* Assistant Professor ARPS.

112. THEORY OF THE EMOTIONS.—A critical and historical survey of the various theories in regard to the affective life with an attempt to formulate a new point of view concerning the nature of the emotions. *Twice a week; first semester.*

[Not given in 1912-13]

113. ABNORMAL PSYCHOLOGY.—The pathological aspects of consciousness; arrested mental development in children and mental disorders in later life. *Twice a week; second semester.* Dr. SUTHERLAND.

114. THE PSYCHOLOGY OF MEMORY.—Two lectures a week and two hours of laboratory demonstration. *Twice a week; first semester.* Assistant Professor ARPS.

[Not given in 1912-13.]

Courses for Graduates and Advanced Undergraduates

No student admitted to any of these courses without at least junior standing and courses in elementary psychology.

3. Experimental Psychology,—The object of this course is to train the student in laboratory methods, and to give him an intimate acquaintance with normal phenomena. *Three times a week; both semesters.* Dr. Sutherland.

5. Genetic Psychology.—This course traces the mental development of the child from birth to maturity. The latter part is devoted to the phenomena of adolescence, and the intellectual problems confronting the body are traced in connection with the mental development. *Twice a week; second semester.* Professor Colvin.

[Not given in 1912-13.]

6. Comparative Psychology.—This course aims at an analysis of animal behavior and its interpretation. *Twice a week; first semester.* Assistant Professor Arps.

[Not given in 1912-13.]

11. Educational Psychology.—The fundamental characteristics of the learning process considered from the biological standpoint; imagination, memory and association, attention and the higher rational processes analyzed. *Three times a week; first semester.* Professor Bagley.

12. Minor Problems in Experimental Psychology.—This is an advanced laboratory course in which special investigations are undertaken by advanced undergraduate students. *Two to five times a week; both semesters.*

Assistant Professor Arps, Dr. Sutherland.

D. The Sciences, Including Mathematics

ASTRONOMY

The prerequisites for graduate study in astronomy are mathematics through the calculus, a year's course in observational astronomy, and a course in college physics.

Course for Graduates

101. SEMINAR.—The work offered to graduate students is largely governed by the preparation and abilities of different individuals. *Three times a week; both semesters.*

Assistant Professor STEBBINS.

[Not given in 1912-13.]

Courses for Graduates and Advanced Undergraduates

7. THEORETICAL ASTRONOMY.—This course begins with the elementary theory of the motions of the heavenly bodies, and is intended to lead the student up to the actual computation of a cometary orbit. *Three times a week; both semesters.*

Dr. REED.

9. CELESTIAL MECHANICS.—A continuation of course 7. Introduction to the theory of disturbed planetary motion. *Three times a week; both semesters.* Dr. REED.

14. OBSERVATIONAL ASTRONOMY.—This course is intended for those who wish to become familiar with the working methods of an astronomical observatory. The problems set for solution are largely individual. *Three times a week; second semester.* Dr. REED.

15. GEODETIC ASTRONOMY.—Advanced work with the sextant, transit, and zenith telescope. *Three times a week; first semester.* Dr. REED.

BOTANY

The work outlined under "Courses for Graduates" is open only to those who have had liberal botanical training including at least one year of successful study in the particular line in which it is desired further to specialize. These courses may be elected for minor or for major work.

Courses for Graduates

101. CYTOLOGY.—The influence of external agents on the cell. Special subjects for investigation are assigned upon con-

sultation. Reports and discussions of current literature and research results. *Twice a week; both semesters.*

Assistant Professor HOTTES.

102. PHYSIOLOGY.—The effects of external stimuli on growth and movement. Special subjects for investigation are assigned upon consultation. Reports and discussions of current literature and research results. *Twice a week; both semesters.* Assistant Professor HOTTES.

103. BACTERIOLOGY.—Investigations upon morphologic and physiological variation due to treatment; systematic studies upon the number, validity, and relationship of species, research upon special saprophytic or parasitic kinds of bacteria and upon methods of favoring or combating their activities. *Twice a week; both semesters.*

Assistant Professor RAHN.

104. MYCOLOGY.—Field and laboratory investigations upon selected groups of fungi. Individual assignments of subjects and problems. *Twice a week; both semesters*

Dr. BARRETT.

106. VEGETABLE PATHOLOGY.—Diseases of plants and disease agents. Special subjects are assigned upon consultation. *Twice a week; both semesters.*

Assistant Professor RAHN and Dr. BARRETT.

Courses for Graduates and Advanced Undergraduates

After at least one year of approved botanical work and further prerequisites, on consultation, graduates may elect any of the courses 3, 7, 8, 9, 10, 16, with assigned additions, for minor credit.

3. CYTOLOGY AND PHYSIOLOGY.—The first semester is devoted mainly to cytology and histology, with special attention to technique; the second, to a study of influences of external stimuli on growth and movement. *Five times a week both semesters.* Assistant Professor HOTTES.

7. PLANT PATHOLOGY.—First semester: the more important diseases of cultivated plants, the causes, and their effects upon the hosts; second semester: methods of investigation and control. *Five times a week; both semesters.* Dr. BARRETT.

8. BACTERIOLOGY.—A detailed study of selected species of

bacteria or investigations upon assigned subjects. *Two to five times a week; both semesters.* Assistant Professor Rahn.

9. Cytology and Physiology, Advanced Course.—Special laboratory problems in certain phases of cytology and physiology. *Twice a week; both semesters.*

Assistant Professor Hottes.

10. Current Literature.—Reports and discussion upon assigned topics and results of research work. *Once a week; both semesters.* Assistant Professor Hottes.

16. Studies upon Special Groups of Plants.—Mostly field, laboratory and herbarium work, and assigned reading. *Two to five times a week; both semesters.* Dr. Barrett

CERAMICS

Courses for Graduates

Persons desiring work in advanced silicate technology should be graduates of courses in ceramics, chemical engineering or general science. Students coming under the last head are required to show sufficient training in inorganic and physical chemistry, mathematics, physics, mineralogy and geology to warrant the expectation that they will be able to do the work elected by them.

101. The theoretical principles underlying the formation of silicates are considered from the modern standpoint, involving the conceptions of physical chemistry. Lectures and laboratory work. *Three times a week; first semester.*

Professor Bleininger.

102. Special problems relating to the technology of the clay industries. Some of the topics which may be selected are: Mineralogical constitution of clays, plasticity and the colloidal state, absorption, pyro-chemical and physical changes, exothermic and endothermic processes, the crystalline and amorphous states of burnt clay, thermal expansion of bodies and glazes, bodies and their interaction with glazes, the composition and constitution of glazes, dissolved and underglaze colors, translucency and opacity, the colors of rare oxides in glazes, eutectic studies, reduction and oxidation phenomena. *Twice a week; both semesters.* Professor Bleininger.

103. Special problems relating to the technology of the cement and mortar industries. Topics: Fusion curves of lime, lime-iron, lime-alumina and lime-iron-alumina silicates, the action of catalyzers, crystallization of basic silicates, constitution of cement compounds, hydration and dehydration, thermal studies, etc. *Twice a week; both semesters.*

Professor BLEININGER.

104. Problems relating to the technology of glass. Topics: Fusion curves of glass silicates, limiting compositions, solubility of the oxides in glasses, devitrification, annealing, optical properties, solubility of glasses, vicosity, thermal expansion, pyro-chemical volume change, etc. *Twice a week; both semesters.* Professor BLEININGER.

CHEMISTRY

Graduate students whose major subject is in some other department than chemistry, before taking graduate work for credit in this department, must have had the equivalent of 15 University hours in chemistry, and the ground covered must have included satisfactory work in general chemistry and in qualitative and quantitative analysis. Such students are advised to take Chemistry 31, 33, 102, 102a, 5b, 5c, 14, and 9a and b. Courses of a more special nature will not, as a rule, be accepted for graduate work unless preceded by one of the above courses.

For students in agriculture 5a and 13b will not be accepted for graduate credit.

Graduate students who are candidates for an advanced degree in chemistry must have had the equivalent of 30 University hours in chemistry, and this must include satisfactory courses in general chemistry, qualitative and quantitative analysis, physical chemistry, and organic chemistry. The physical chemistry requires also one year's work in physics as a prerequisite. Before receiving the degree of Doctor of Philosophy such students are expected to complete work equivalent to courses 31, 33 (or 102 and 102a), 14, 9a, 9b, 101 and 111. They are advised to take at least brief courses in gas analysis, iron and steel analysis, water analysis, assaying, and chemical technology.

For students in chemistry 5a, 13a, 9 and 9c will not be accepted for graduate credit and 9a, 9b, 14, 31 and 33 will be accepted only from students entering the Graduate School with the equivalent of 30 University hours in chemistry.

Courses for Graduates

102. Advanced Physical Chemistry.—This course consists of lectures and seminar meetings and, together with 102a, is intended to cover a period of two years. The subject is treated from the standpoint of *Avogadro's Principle and Thermodynamics.*

The primary purpose of this course is to develop power to handle successfully a physico-chemical problem rather than merely to impart a knowledge of the phenomena and the principles involved. *Nernst's Theoretische Chemie, 5th edition. Twice a week; both semesters.*

Assistant Professor Washburn.

102a. Advanced Physical Chemistry.—A continuation of course 102. This course alternates with course 102. *Nernst's Theoretische Chemie. Twice a week; both semesters.*

Assistant Professor Washburn.

[Not given in 1912-13.]

102b. Advanced Electrochemistry.—This course deals with the modern theories of solution and the principles of thermodynamics in their application to the problems of electro-chemistry. The subjects of electrolytic conductivity and transference, electromotive force, and the energy principles underlying the transformations of chemical and electrical energy are discussed in detail. *LeBlanc's Electrochemistry. Three times a week; second semester.* Dr. Jones.

102c. Advanced Physical and Electrochemistry.—A laboratory course dealing with the applications of physico-chemical methods to special problems. The nature of the experiments performed by the student will depend upon his previous training in this subject and his purpose in taking the course. The experiments are designed to develop the power of independent thinking in applying physico-chemical methods to problems in the laboratory. This course must be

preceded or accompanied by courses 102, 102a, or 102b. *Twice a week; first semester.*

Assistant Professor WASHBURN, Dr. JONES.

102d. ELECTROCHEMISTRY.—This course, which is intended primarily for students of electrical engineering, includes a discussion of theoretical and applied electrochemistry with the emphasis chiefly on the technical side of the subject. *Once a week; both semesters.* Dr. JONES.

102e. SPECIAL TOPICS IN PHYSICAL CHEMISTRY.—A detailed study of certain branches of physical chemistry and its applications will be taken up in this course. The course will be conducted on the seminar plan and the topics considered will vary from year to year. Subject for 1912-13: Physical Properties of Chemical Substances. *Smiles' "Chemical Constitution and Physical Properties." Once a week; first semester.*

Assistant Professor WASHBURN.

103. ADVANCED INORGANIC CHEMISTRY.—A systematic presentation of descriptive inorganic chemistry, including the rarer elements and based on the periodic system. The work consists of two lectures a week throughout the year, which may or may not be accompanied by laboratory work on advanced inorganic preparations. *Two to five times a week: both semesters.* Assistant Professor BALKE.

103a. ADVANCED ANALYTICAL CHEMISTRY.—The lectures will deal with special topics in analytical chemistry, and may or may not be accompanied by laboratory work. *One to five times a week; second semester.* Dr. BURGESS.

103b. SPECIAL TOPICS IN INORGANIC CHEMISTRY.—A detailed study of certain branches of inorganic chmistry will be taken up in this course. The course will be conducted on the seminar plan and the topics considered may vary from year to year. *Werner's Neuere Anschauungen auf dem Gebiete der anorganischen Chemie. Once a week; both semesters.*

Dr. SMITH.

104. THEORETICAL ORGANIC CHEMISTRY.—A seminar and lecture course. Among the chapters discussed are: Kekule's Linking Theory, Stereochemistry, Stearic Hindrance, Molecular Rearrangements, Tautomerism, etc. Special attention is given to the application of modern physical chemistry to the study of organic problems, especially the application of

chemical kinetics to Tautomerism and the application of physical properties to the determination of chemical structure. *Twice a week; both semester.* Dr. Derick.

104a. Advanced Organic Chemistry. This course consists of two lectures a week with assigned reading and is especially recommended to students doing research work in this subject. Special attention is given to the detailed study of recent research methods in such fields as: Condensation, carbohydrates, fermentation, and enzyme action, the purine group, the proteins, the relation of color to chemical constitution, alkaloids, etc. The chapters may be varied from year to year. *Twice a week; first semester.* Alternates with 104. Dr. Derick.

[Not given in 1912-13.]

105. Advanced Physiological Chemistry.—Selected portions of physiological chemistry not covered by chemistry 15. *Three times a week; second semester.* Professor Hawk.

105a. Advanced Physiological Chemistry.—Special investigations. Laboratory. *Two to five times a week; second semester.* Professor Hawk, Dr. Howe.

105b. Advanced Physiological Chemistry.—A critical consideration of recent contributions of importance in the field of physiological chemistry. *Once a week; both semesters.* Professor Hawk.

106. Animal Chemistry.—A lecture course consisting of a critical study of the recent advances in the chemistry of nutrition of the lower animals, and a detailed study of the chemistry of the functional products, such as flesh, fat, milk, wool, etc., of the more common domesticated animals. *Twice a week; both semesters.* Professor Grindley.

110. Water Supplies.—A study of the sources of contamination of water supplies and the purification of water for potable or technical use. *One to five times a week; both semesters.* Professor Bartow.

111. Research.—*Once a week; both semesters.*

Physical and Electrochemistry.—Assistant Professor Washburn, Dr. Jones.

Inorganic Chemistry.—Assistant Professor Balke, Dr. Smith.

Analytical Chemistry.—Dr. Burgess.

FOOD CHEMISTRY.—Dr. BEAL.

ORGANIC CHEMISTRY.—Professor NOYES, Assistant Professor CURTISS, Dr. DERICK.

SANITARY CHEMISTRY.—Professor BARTOW.

PHYSIOLOGICAL CHEMISTRY.—Professor HAWK.

ANIMAL CHEMISTRY.—Professor GRINDLEY.

INDUSTRIAL CHEMISTRY.—Professor PARR, Assistant Professor MCFARLAND.

Courses for Graduates and Advanced Undergraduates

5c. FOOD ANALYSIS.—The elements of quantitative organic analysis, with special reference to the examination of food and drug products. A study of alcohols, carbohydrates, fats and oils, animal and vegetable foods, nitrogenous bodies, preservatives and colors. Should be preceded by organic chemistry. Sherman's "Organic Analysis", "Bulletin 107, rev., U. S. Bureau of Chemistry." *Five times a week; second semester.* Dr. BEAL.

6*. CHEMICAL TECHNOLOGY.—This is a course of lectures comprising a study of technological chemistry as illustrated in those industries having a chemical basis for their principal operations and processes. Much use is made of the journals. *Thorp's Industrial Chemistry* is used as a guide. No laboratory work. *Twice a week; second semester.*

Professor PARR.

7*. METALLURGY.—A general course in metallurgical processes. Lectures and assigned reading. *Three times a week; first semester.* Professor PARR.

8. IRON AND STEEL ANALYSIS.—Analyses are made of all the constituents by both rapid, or technical, and standard methods. *Three times a week; second semester.*

Dr. BURGESS.

9a. ORGANIC SYNTHESIS.—Laboratory work for students of the chemical course, in ultimate organic analysis and the preparation and study of typical organic compounds, to accompany Chemistry 14. *Twice a week; first semester.*

Assistant Professor CURTISS, Dr. DERICK.

*Certain inspection trips will be arranged in connection with courses 6 and 7. Students registering in these courses should take into consideration the expense involved, which will approximate $15.00 for each course.

9b. Organic Synthesis and Analysis.—Continuation of 9a, to accompany Chemistry 14. *Twice a week; second semester.* Assistant Professor Curtiss, Dr. Derick.

10a. Study of Water Supplies.—Lectures on history, sources, contamination, and standards of purity of potable waters and waters for industrial purposes, together with practice in analytical methods. *Three times a week; second semester.* Professor Bartow.

13b. Advanced Agricultural Analysis.—This course is offered to students who wish to specialize in agricultural chemistry or agricultural experiments. Applied quantitative analysis. The analyses of fungicies, limestone, phosphate rock, fuel and water, determination of the alkali metals, special methods of agricultural analysis. Treadwell-Hall, "Analytical Chemistry", Vol. II. *Five times a week; second semester.* Dr. Beal.

14. Organic Chemistry.—This course consists of lectures and recitations upon the fundamental principles and more important compounds of organic chemistry. *Noyes's Organic Chemistry.* This course must be accompanied by Chemistry 9a and 9b. *Three times a week; both semesters.* Professor Noyes.

15. Physiological Chemistry.—This course is designed especially for students desiring a knowledge of the fundamental principles of physiological chemistry. It consists of lectures, demonstrations, conferences, practical work, and assigned reading. The course includes a systematic study of enzymes, carbohydrates, salivary digestion, gastric digestion, fats, pancreatic digestion, intestinal digestion, bile, putrefaction products, feces, blood, milk, epithelial and connective tissue, muscular tissue, nervous tissue, urine. The work on gastric juice, blood, urine, and milk is both qualitative and quantitative, and all the clinical aspects of these topics are treated thoroughly for the prospective student of medicine. *Hammarsten's Text Book of Physiological Chemistry; Hawk's Practical Physiological Chemistry. Five times a week; first semester.* Professor Hawk, Dr. Howe.

15a. Metabolism and Nutrition.—Metabolism; activities of gastro-intestinal tract; enzymes; inorganic nutrition, etc. *Twice a week; second semester.* Professor Hawk.

21. Qualitative Organic Analysis.—A course of laboratory practice for advanced students in systematic methods for the identification of organic compounds. *Twice a week; first semester.* Dr. Derick.

22. Animal Chemistry.—A course for the detailed study of the chemical composition of animal products and feeding stuffs. *Three to five times a week; first or second semester.* Professor Grindley.

27. Qualitative Analysis of the Rare Elements.—A detailed study of rare elements and their compounds. The work consists mainly in the identification and separation of the elements and the study of formation, solubilities, and chemical reactions of their salts. Reading is assigned in connection with laboratory work. *Three times a week; second semester.* Assistant Professor Balke.

31. Elementary Physical Chemistry.—This course is designed to present, in an elementary manner, some of the more important principles and methods of physical chemistry and electro-chemistry. Instruction is given by lectures and recitations. To secure familiarity in applying the laws and principles of physical chemistry to practical problems in other branches of chemistry, the student is expected to solve numerous problems in connection with this course. *Three times a week; second semester.* Assistant Professor Washburn, Dr. Strachan.

32. Elementary Physical Chemistry.—A laboratory course to accompany course 31. The experiments performed include the methods of determining molecular weight both in the gaseous state and in solution; the application of the principles relating to chemical equilibrium; the measurement of the electrical conductivity of solutions and the application of this property in interpreting the phenomena occurring within the solution; and the illustration of some of the fundamental conceptions of thermochemistry. *Twice a week; second semester.* Dr. Jones, Dr. Strachan.

35. Electrochemistry.—Recitations or lectures and laboratory work dealing with the practical applications of electrochemistry in the industries; intended for students going into technical work. The study of patents is made an important feature of the course, each student being required to

collect, study and report upon the more important patents in some selected industry. *Thompson's Applied Electrochemistry.* See also Chemistry 102b. *Three times a week; first semester.* Dr. Jones.

50. History and Theory of Chemistry.—A discussion of the historical development of the science of chemistry. *Twice a week; first semester.* Dr. Smith.

66. Technology of Gases.—Lectures, reading, and reports on the manufacture, constituents, and uses of the various forms of gaseous fuel. The laboratory work will include calorimetry, photometry, and some of the more usual methods of analysis. *Once a week; second semester.* Dr. Jesse.

68a. Analysis of Glasses and Glazes.—For students in ceramics. A study of methods and practice on special problems connected with the pottery industry. *Three times a week; first semester.* Dr. Burgess.

70. Advanced Assaying and Ore Testing.—The assay of complex ores of platinum, tin, and copper; bullion assay, free milling, amalgamation, and cyaniding tests. *Twice a week; second semester.* Assistant Professor McFarland.

72. Paints, Oils, Turpentines, Varnishes, and Protective Coverings for Wood and Metals.—Lectures and laboratory. *Twice a week; first semester.* Professor Parr.

76. Calorimetry of Fuels.—An advanced course in the study of methods for determining the heat values of solid, liquid, and gaseous fuels. *One to three times a week; both semesters.* Professor Parr.

77. Composition and Classification of Coal.—A lecture and reading course on the composition of coal with reference to its classification, changes in composition, weathering, spontaneous combustion, formation of mine gases, etc. *Once a week; second semester.* Professor Parr.

78. Metallography.—Lectures, reading and laboratory work on the constitution and microstructure of metals and alloys and on the relations between their properties, chemical and mechanical treatment and structure. *Twice a week; second semester.* Assistant Professor McFarland.

93. Journal Meeting.—For juniors, seniors, and graduates. *Once a week; both semesters.*

ENTOMOLOGY

The prerequisite for graduate work in entomology is a year's work in college zoology, or a half a year's work in zoology and a year's work in botany. Entrance upon major work in entomology requires the equivalent of Entomology 2 and 3. Courses 108 and 109 require 8 and 9 respectively.

Courses for Graduates

102. Research in the Morphology and Embryology of Insects. *Twice a week; both semesters.*
Assistant Professor Folsom.

103. Research in Faunistic and Ecological Entomology. *Once or twice a week; both semesters.* Professor Forbes.

108. Research in Economic Entomology. *Once or twice a week; both semesters.* Professor Forbes.

109. Research in Systematic Entomology. *Twice a week; both semesters.* Assistant Professor MacGillivray.

Courses for Graduates and Advanced Undergraduates

2. General Entomology.—Field entomology; morphological and physiological entomology; the collection and preservation of specimens; laboratory studies of typical insects; the recognition of adaptive structures and their utilities. (This course and course 3 form a year's work, covering the whole field. Either may be taken independently of the other.) *Five times a week; first semester.*
Assistant Professors Folsom and MacGillivray.

3. General Entomology.—The classification and determination of insects; the study of life histories in the insectary and by field observation; the collection of information with respect to the ecological relations of insects. *Five times a week; second semester.* Assistant Professor Folsom.

5. Introduction to Research.—Library, language, manuscript, and advanced laboratory work on assigned topics. *Three to five times a week; first or second semesters.*
Professor Forbes, Assistant Professors Folsom and MacGillivray.

7. Systematic Entomology.—The external anatomy of insects; the terminology of the parts; identification of specimens representing as many as possible of the major groups. *Five times a week; first or second semester.*

Assistant Professor MacGillivray.

8. Economic Entomology.—Field, laboratory, insectary, library, and manuscript work, with practice in some of the special operations of economic entomology. Preparation for individual study of other classes of insect pests. *Three times a week; both semesters.*

Professor Forbes, Assistant Professor Folsom.

9. Advanced Systematic Entomology.—The identification of the characters upon which genera and species are based. *Five times a week; first or second semester.*

Asssistant Professor MacGillivray.

10. Taxonomy of Immature Insects. *Five times a week; first semester.* Assistant Professor MacGillivray.

11. Classification of the Coccidae.—Methods of preparing scale insects for study, the identification of genera and species, and discussion of their morphology, metamorphosis, and phylogeny. *Five times a week; second semester.*

Assistant Professor MacGillivray.

12. Current Literature.—Reports and discussion upon assigned topics; presentation and discussion of contents of recent entomological publications, and of results of personal research. *Once a week; both semesters.*

13. Medical Entomology.—Primarily for advanced students preparing for medicine. A study of insects as related to the transmission of disease. Laboratory observations and experiments, and written reports, with discussions upon literature of the subject. Methods of controlling insects capable of transmitting diseases. *Three times a week; first or second semester.* Assistant Professor Folsom.

14. Advanced Economic Entomology.—Personal work, under direction, in the insectary, field, and library, with assigned problems in economic entomology involving observation, experiment, and inference, note making, record keeping, and the preparation of manuscript. Intended to prepare advanced students for immediate service as entomologists in experiment stations and other state and government posi-

tions. Advantage will be taken of the operations and practical problems of the State Entomologist's Office, so far as available for the purposes of this course. *Twice a week; first or second semester, and six weeks of summer vacation.*

Professor FORBES.

GEOLOGY

The first prerequisite for graduate work in Geology is the equivalent of the complete undergraduate offerings in that branch of the subject in which specialization is desired. Those who wish to specialize in Paleontology should have, in addition, at least an elementary knowledge of Systematic Zöology; those who wish Physical Geography should have a fairly thorough knowledge of General Physics and Chemistry; and those who expect to pursue work in Petrography and Economic Geology should be well grounded in General Physics, Inorganic Chemistry and the elements of Physical Chemistry. All graduate students should be sufficiently acquainted with German and French to be able to read the journals printed in these languages.

Courses for Graduates

101. ADVANCED CRYSTALLOGRAPHY.—This course is intended to familiarize the student in chemistry or mineralogy with the methods used in measuring, projecting and calculating crystal forms, and determining the physical properties of crystalized bodies. *Three to five times a week; both semesters.* Associate Professor BAYLEY.

102. PETROGRAPHY.—Lectures and laboratory work on the crystalline and fragmental rocks including identification of types, classification and relationships. *Three to five times a week; both semesters.* Associate Professor BAYLEY.

105. INVERTEBRATE PALEONTOLOGY.—A course devoted to the study of a group of invertebrate fossils, or of the fossils of a special geological system; their geographic distribution and geologic range with reference to stratigraphy. Largely individual work. *Three to five times a week.*

Assistant Professor SAVAGE.

106. Field and Laboratory Course.—A course consisting of a systematic study of the geology and paleontology of a selected area in Illinois. A carefully prepared report on the geology of the region, based on the data collected in the field, is required. *Three to five times a week.*

Assistant Professor Savage.

107. Areal and Structural Geology.—Individual work on some area exhibiting important structural or economic features. *Once a week.* Associate Professor Bayley.

124. Advanced Physiography.—Individual work on field problems, with study and discussion of the more advanced literature of physiography and geomorphology. *One to three times a week.* Dr. Rich.

Courses for Graduates and Advanced Undergraduates

6. Physical and Optical Mineralogy.—A direct introduction to the courses in Petrography. The physical and optical properties of minerals are discussed with special reference to symmetry. The larger portion of the work is devoted to the study of polarized light and its practical use in identifying the rock-forming materials. *Five times a week; second semester.* Associate Professor Bayley

7. Petrography.—The principles learned in course 6 are applied to the study of rocks. Lectures describe the different types of these rocks and discuss their origin and classification. In the laboratory a representative suite of specimens is studied in the hand specimen and thin section. *Five times a week; first semester.* Associate Professor Bayley.

9. Paleontology.—A study of invertebrate fossils, their classification and relationships. Instruction is given in the identification of the fossils, and in the finding and use of the literature of the subject. *Five times a week; first semester.*

Assistant Professor Savage.

16. Stratigraphy.—This course follows course 9, and is a study of principles of classification of rock formations, of the methods and criteria employed in correlation, of the characterstic invertebrate faunas of the successive geologic formations and their distribution, and of the use of these in the interpretation of stratigraphy. *Five times a week; second semester.* Associate Professor Savage.

HOUSEHOLD SCIENCE

Students who wish to do graduate work in Household Science will find it to their advantage to specialize in either the scientific or the economic phases of the subject. In either case they should be able to offer an equivalent for twenty hours of household science given in the University of Illinois, with a minimum of two years of chemistry, including organic chemistry, a year of biological science, and a year of either economics or sociology.

Courses for Graduates

101. HOME ECONOMICS.—A study of the origin and development of home economics, with particular reference to its industrial, educational, and sociological aspects. *Twice a week; both semesters.* Professor BEVIER.

102. SPECIAL INVESTIGATIONS.—Problems in the application of the principles of bacteriology, chemistry, and physiology, to the ordinary processes used in preparation of food. *Twice a week; both semesters.*

Professor BEVIER, Assistant Professor GOLDTHWAITE.

Courses for Graduates and Advanced Undergraduates

4. FOOD AND NUTRITION.—An application of the principles of pure science to the problems of food and nutrition. The problems may be physiological, chemical or bacteriological. *Five times a week; first semester.*

Professor BEVIER, Assistant Professor GOLDTHWAITE.

5. DIETETICS.—The work in dietetics includes the following topics: The principles of diet, the relation of food to health; influence of age, sex, and occupation in diet; the construction of dietaries; dietetic treatment of certain diseases. *Three times a week; second semester.*

Associate Professor GOLDTHWAITE.

MATHEMATICS

Library Facilities.—The mathematical library of approximately 2,500 volumes, is in a room in the Natural History Building, to which all graduate students have easy access.

In addition to thirty-five Mathematical journals kept in the department seminar room, the general University library receives regularly about 1,600 periodicals, a considerable number of which are partly devoted to mathematics. We mention in particular the proceedings of various scientific societies such as, for example: Les Comptes Rendus de l'Académie des Sciences (Paris); Sitzungsberichte der k. Akademie (Berlin); Nachrichten der Gesellschaft der Wissenschaften zu Göttingen; Transactions of the Royal Society (London), etc.

Models, Apparatus, Etc.—The department has in its possession a collection of models for instruction and research in analysis, geometry, and kinematics This collection contains a large number of plaster of Paris casts from the famous collections of Schilling and Wiener, illustrating the properties of surfaces of the first four orders and of the differential properties of surfaces in general. A considerable number of string models are available for demonstrating the properties of ruled surfaces and space curves; other models of wire and celluloid serve to make clear the peculiarities of space curves, in particular those of the third order. Plaster models, some of which have been originated and constructed by students under the guidance of instructors at the University, illustrate important points in the theory of functions. The collection also contains a number of kinematic models illustrating the generation of trochoids of various kinds, inversors, etc.

The department possesses a collection of computing machines, slide rules of various kinds, planimeters, integraphs, a harmonic analyser, etc.

Previous Training.—Students entering upon graduate study in mathematics should have had a course in calculus extending through the year and a course in the theory of equations, or in differential equations.

Courses for Graduates

100. SEMINAR.—*Three times a week; both semesters.* Professor TOWNSEND, Professor MILLER, Associate Professor RIETZ, Assistant Professor SISAM, Assistant Professor SHAW, Assistant Professor EMCH.

101. FUNCTIONS OF REAL VARIABLES.—An introduction to the theory of functions of real variables, making use of the general principles of the theory of assemblages. *Three times a week; both semesters.* Professor TOWNSEND.

[Not given in 1912-13.]

102. FOURIER'S SERIES.—This course is intended for students both of pure mathematics and of the physical sciences. It consists of a consideration of the elementary theory of Fourier's and allied series, followed by detailed discussion of physical applications and consideration of classical and recent researches concerning the properties of Fourier's and allied series and operations upon them. *Three times a week; both semesters.* Assistant Professor SHAW.

103. THEORY OF POTENTIAL.—The elements of the theory of logarithmic and Newtonian potential functions. Green's theorems and functions. Boundary value problems. Applications to physical problems. *Three times a week; both semesters.* Assistant Professor SHAW.

[Not given in 1912-13.]

110. ELLIPTIC FUNCTIONS.—The elements of the theory of elliptic functions with applications to geometry and mechanics. Introduction to the theory of the elliptic modular functions. *Three times a week; both semesters.*

Assistant Professor EMCH.

111. AUTOMORPHIC FUNCTIONS.—An introduction to the theory of automorphic functions. The first semester will be devoted mostly to the group-theoretic side of the theory; the second semester will be concerned with the function-theoretic developments and applications. *Three times a week; both semesters.*

[Not given in 1912-13.]

113. THEORY OF LINEAR DIFFERENTIAL EQUATIONS.—*Three times a week; both semesters.* DR. CRATHORNE.

120. Elementary Theory of Groups.—The study of the groups which present themselves in arithmetic, geometry, and trigonometry is followed by a determination and study of those which can be represented with a small number of letters. The latter part of the course is devoted to abstract group theory and the Galois theory of equations. *Three times a week; both semesters.* Professor Miller.

121. Theory of Groups.—Second course. This course presupposes about one year's work in group-theory. It is devoted to special topics depending upon the needs of the class. The early part of the course is given to the consideration of recent advances and methods along these special lines, and the latter part to research. *Three times a week; both semesters.* Professor Miller.

[Not given in 1912-13.]

124. Theory of Numbers.—The principal subjects considered in this course are: congruences, Kronecker's modular systems, quadratic residues, quadratic forms and algebraic numbers. *Three times a week; both semesters.*

Professor Miller.

[Not given in 1912-13.]

129. Theory of Statistics.—The general methods of statistical investigation, the application of the theory of probability to statistical data, the fitting of curves to observation, interpolation, theory of errors, and the mathematical theory of variability and correlation, the application of the principles developed to problems in economics, sociology, and biology. *Three times a week; both semesters.*

Associate Professor Rietz.

[Not given in 1912-13.]

130. Invariants and Higher Plane Curves.—This course includes the general theory of algebraic curves, together with the application of the theory of invariants to higher plane curves. Special study is made of curves of the third and fourth order. *Three times a week; both semesters.*

Assistant Professor Sisam.

[Not given in 1912-13.]

131. Algebraic Surfaces.—In this course are considered the application of homogeneous coördinates and the theory of invariants to geometry of three dimensions, and also the gen-

eral theory of surfaces, together with the special properties of surfaces of the third and fourth order. *Three times a week; both semesters.* Assistant Professor SISAM.

[Not given in 1912-13.]

135. DIFFERENTIAL GEOMETRY.—Applications of the calculus to the general theory of curves and surfaces based primarily on the use of Cartesian coördinates. Relation of the theory of surfaces to the theory of invariants of a pair of quadratic differential forms. *Three times a week; both semesters.*

141. VECTOR METHODS.—Principles of quaternions and comparative study of the methods of Gibbs and Grassman. Applications to geometry and mechanics. Linear vector operations and applications to elasticity and deformable media. The differentiator of Hamilton with applications. Differential and integral invariants. Vectors in four dimensions. *Three times a week; both semesters.* Assistant Professor SHAW.

Courses for Graduates and Advanced Undergraduates

10. THEORY OF EQUATIONS AND DETERMINANTS.—Some of the fundamental properties of an algebraic equation in one unknown; the solutions of systems of simultaneous equations; theory of a system of linear equations; some fundamental properties of determinants. *Three times a week; second semester.* Professor MILLER.

16. DIFFERENTIAL EQUATIONS.—This course embraces the following topics: General linear equations with constant coefficients, special forms of differential equations of higher order, integration in series, etc. *Twice a week; first semester.* Professor TOWNSEND.

17a. ADVANCED CALCULUS.—This course begins with the consideration of the fundamental notions and theorems of the calculus from a more advanced and critical point of view. This is followed by the study of certain more advanced topics in the integral calculus, including elliptic integrals and functions defined by definite integrals. *Three times a week; second semester.* Dr. LYTLE.

19a. SOLID ANALYTICAL GEOMETRY.—A general review of the equations of the plane and the right line in space and the

more general properties of surfaces of the second degree. The classification and special properties of quadrics, and a brief introduction to the theory of surfaces in general. *Three times a week; second semester.* Assistant Professor SISAM.

20. CALCULUS OF VARIATIONS.—This course has for its aim merely to acquaint the student with those elements of the science which are most needed in the study of the higher subjects of mathematical astronomy and physics. *Three times a week; second semester.* Dr. CRATHORNE.

21a. METHOD OF LEAST SQUARES.—The fundamental principles of the subject. The following topics are studied: Law of probability and error, adjustment of observations, precision of observations, independent and conditional observations, etc. *Twice a week; first semester.*

Assistant Professor STEBBINS.

22a. PARTIAL DIFFERENTIAL EQUATIONS.—This course deals with the integration and determination of the integration constants of such partial differential equations as arise in the study of such subjects as the flow of heat, the vibration of strings, plates, etc., and electricity. *Twice a week; second semester.* Dr. WAHLIN.

24a. FUNCTIONS OF A COMPLEX VARIABLE.—A general introduction to the theory of function of a complex variable. *Three times a week; both semesters.* Professor TOWNSEND.

27. PROJECTIVE GEOMETRY.—Fundamental concepts; anharmonic ratio; projective pencils and ranges; projective transformations and groups, theory of conics and quadric surfaces; pencils and ranges of conics; quadratic transformations and projective theory of cubics; application to mechanics. *Three times a week; both semesters.*

Assistant Professor EMCH.

[Not given 1912-13.]

31. ACTUARIAL THEORY.—The application of probability to life contingencies, the construction and graduation of mortality tables, the elements of fire insurance and the calculation of premiums for various types of insurance. *Three times a week; first semester.* Associate Professor RIETZ.

32. HISTORY OF MATHEMATICS.—A general view of the historical development of the elementary subjects and an outline of the rise and growth of the higher mathematics chiefly

in the nineteenth century grouped about the persons most influential in this development. Lectures and reports on assigned reading. *Twice a week;; second semester.* Dr. Lytle.

33. Modern Algebra.—This course includes a consideration of the following topics: theory of matrices; system of linear equations; bilinear and quadratic forms; properties of polynomials; algebraic invariants; and elementary divisors. *Three times a week; both semesters.* Dr. Börger.

40. Fundamental Concepts of Mathematics.—Development of the number concept; concepts of unity, aggregate, order and correspondence; irrationals and limits, transcendence of e and π; parallel axiom and non-euclidian geometries; ruler and compass constructions; function; logic of mathematics. *Twice a week; second semester.* Dr. Lytle.

PHYSICS.

The prerequisite for graduate work in physics is a college course in general physics with a year's laboratory course in introductory physical measurements. The student who is to do major work in physics should also have had additional courses in physics or teaching experience, unless the training in his minor subjects, mathematics or chemistry, has been strong and complete. He should also have a knowledge of French and German sufficient to use references in these languages. The courses named below are those open for candidates for the Master's or Doctor's degree. A large part of the last year's work of the candidate for the Doctor's degree is investigational, along either the experimental or the theoretical side of physics. In addition to these major graduate courses, the courses in elementary dynamics, heat, light, electrical measurements, and introductory electrical theory, are arranged with certain additions for graduate credit. The "intermediate" courses on heat, light and electricity and magnetism, may be offered by students making a minor in physics.

Courses for Graduates

121. Recent Advances in Physical Science.—Lectures illustrated by experiments on the more recent developments

of physics. Students regularly registered in this course are required to make written reports giving an original discussion of one or more of the topics discussed during the semester.

Assistant Professor KNIPP.

[Not given in 1912-13.]

123. SOUND.—Lectures and recitations. Rayleigh's Sound, Auerbach's Akustik and Barton's Sound are used as reference texts. *Twice a week; both semesters.*

Assistant Professor WATSON.

124. CONDUCTION OF ELECTRICITY THROUGH GASES.—Lectures and discussions on the electrical conductivity of gases, ions and ionisation, the effect of a magnetic field, the motion of ions, spark discharge, cathode rays, Roentgen rays, canal or positive rays, and related phenomena of radioactivity. *Three times a week; both semesters.*

Assistant Professor KNIPP.

126. PHYSICS COLLOQUIUM.—Weekly meetings of the instructors and advanced students of the department for the presentation and discussion of papers on current problems in Physics. Many of these papers are on investigations in progress in the laboratory and experimental demonstrations are used. Attendance on this colloquium is expected of all the graduate students though it is not registered, except in the cases of those making special reports on original investigations. *Once a week; both semesters.*

127. ELECTRON THEORY.—The theories of the constitution of the atom, and the phenomena of the emission and absorption spectra will be studied from a theoretical point of view. This course will have the character of a seminar. The course should be of especial interest to students in advanced chemistry. *Twice a week; second semester.*

Assistant Professor KUNZ.

131. INVESTIGATION OF SPECIAL PROBLEMS.—An advanced course in laboratory or in design and calculation. A problem is chosen and worked out with the advice and direction of the instructor. *Two to four times a week; both semesters.*

Professor CARMAN, Assistant Professors KNIPP, WATSON, SCHULTZ, KUNZ, and Dr. WILLIAMS.

132. MATHEMATICAL PHYSICS.—Special phases in theoretical physics.

(a) Dynamics.—First part: dynamics of a material system; determination of the center of gravity; of moment of inertia and of potentials. Second part: the principle of least action; Lagrange's equations; motions of the top and applications. *Three times a week; both semesters.*

Assistant Professor KUNZ.

[Not given in 1912-13.]

(b) ELECTRODYNAMICS.—Lectures and collateral reading on the principles of electrodynamics. Jean's Mathematical Theory of Electricity and Magnetism is used especially for the sake of the problems, a large number of which will be solved. The potential theory is the basis of the course which involves as mathematical tools, spherical harmonics, conjugate functions and some theorems of the vector analysis. A large number of capacities, coefficients of self and mutual induction are determined. Special attention is paid to the theory of absolute electrical measurements and to the condenser discharge with its application in wireless telegraphy. Maxwell's theory is studied with some applications in optics, such as the optical properties of metals. The course ends with a general review of the modern modifications of Maxwell's theory, that is, the theory of relativity and the electromagnetic emission theory of light. This course is continued in the following year in No. 132d.

Assistant Professor KUNZ.

(c) THERMODYNAMICS.—Fundamental principles with applications to physical and chemical phenomena. Lectures; recitations. *Three times a week; both semesters.*

Assistant Professor KUNZ.

[Not given in 1912-13].

(d) THEORY OF ELECTRICAL OSCILLATIONS AND CYLINDRICAL HARMONICS.—Electrical oscillations along parallel wires, the vibrations from a Hertz oscillator and from an antenna, the resonance phenomena between sending and receiving stations and the absorption of electrical waves, are studied in the first part of the course. Cylindrical harmonics are used in problems of a vibrating membrane, of the conduction of heat and electricity through cylinders and of electrical waves proceeding along wires. *Twice a week; both semesters.*

Assistant Professor KUNZ.

[Not given in 1912-13].

133. SEMINAR.—*Three or five times a week; both semesters.*

Professor CARMAN, Assistant Professors KNIPP, WATSON, SCHULZ, KUNZ.

Courses for Graduates and Advanced Undergraduates

4. ELECTRICAL AND MAGNETIC MEASUREMENTS.—Laboratory exercises with discussions and recitations. The course extends throughout the year. It is recommended to those wishing a comprehensive course in exact electrical and magnetic measurements. *Twice a week; both semesters.*

Assistant Professor KNIPP, Dr. WILLIAMS, Mr. SMITH.

14. DYNAMICS AND ADVANCED GENERAL PHYSICS.—An introduction to theoretical physics involving the use of the calculus. The first semester is devoted to dynamics with an introduction to the mechanical theory of heat. The second semester gives the elementary mathematical theory of electricity and magnetism, with some chapters on wave motion. *Three times a week; both semesters.* Professor CARMAN.

20a. LIGHT.—Special phenomena; modern theories; reading in texts of Drude, Wood, and Preston. Lectures; recitations. *Twice a week; first or second semester.*

Assistant Professor SCHULZ.

20b. LIGHT.—Light measurements. Laboratory. *Two to five times a week; first or second semester.*

Assistant Professor SCHULZ.

23. SOUND.—Lectures; recitations; experiments. *Twice a week; second semester.* Assistant Professor WATSON.

25. HEAT.—A course of text-book, lecture and laboratory exercises. *Twice a week; second semester.*

29. ELECTRICAL OSCILLATIONS.—Oscillating currents for both low and higher frequencies with particular attention in the second semester to the theory of wave telegraphy and telephony. *Three times a week; both semesters.*

Professor CARMAN.

30a. INTRODUCTION TO THEORETICAL ELECTRICITY.—A course of lectures and recitations discussing the phenomena with elementary calculus methods, and with occasional lecture-

room demonstrations. References: Foster and Porter's Electricity and Magnetism, Thomson's Elements of Electricity and Magnetism. *Twice a week; both semesters.*

Assistant Professor KNIPP.

30b. ELECTRICITY AND MAGNETISM.—A course of electrical measurements, including self and mutual induction, standardization and calibration work, electrical discharge through gases, etc. *Two, three or five times a week; first or second semester.* Dr. WILLIAMS.

31. SPECIAL PROBLEMS IN ADVANCED PHYSICAL MEASUREMENTS.—*Two or three times a week.*

Professor CARMAN, Assistant Professor KNIPP AND Dr. WILLIAMS.

PHYSIOLOGY

Students intending to undertake graduate work in Physiology will be expected to have the equivalent of two years of work in chemistry, and two years of biology, at least one year of which must be in zoölogy and cover the fundamentals of the subject, including embryology.

Course for Graduates

103. RESEARCH.—Every facility and encouragement, so far as the resources of the laboratory and library permit, are offered to those prepared to avail themselves of these, for research as part of the work for the Master's or the Doctor's degree, or for carrying on original work for publication. The research equipment of the laboratory is adequate for work in the subjects of histology, physiology and pathology. *Once a week; first and second semesters.*

Courses for Graduates and Advanced Undergraduates

1. HISTOLOGY.—This course consists of a study of the fundamental mammalian tissues, and the microscopic anatomy of the organs. Lectures and laboratory. *Five times a week; first semester.*

2. PHYSIOLOGY.—This includes a study of the physiology of nerve and muscle, circulation, respiration, secretion, diges-

tion, metabolism, etc. Lectures and laboratory work. *Five times a week; second semester.*

5. Special Physiology.—This course is given to meet an emergency, which sometimes arises, where a student wishes to take up a special line of work not specified in one of the other courses, and not involving the preparation of a thesis. At the discretion of the head of the department students may register for such work. Arrange details with instructor. *Two to five times a week; both semesters.*

7. Physiological Journal Club.—The club is composed of the teaching staff of the department, the graduate students, and such undergraduates as are sufficiently advanced to participate. Recent articles of interest in current journals are reported and discussed. *Once a week.*

ZOÖLOGY

The equipment of the department includes the usual apparatus, microscopes, microtomes paraffin baths, demonstration material and reagents. The various special laboratories are quipped with special apparatus and demonstration material in accordance with their particular needs. Provision is made for meeting such special demands for material, apparatus and literature as may arise in connection with individual work.

The University Museum contains a valuable series of mounted vertebrates, of Ziegler embryological models, and of alcoholic material in all groups; these are available as needed for either teaching or research.

The extensive collections and library of the Illinois State Laboratory of Natural History are freely available to advanced students. They are unusually rich in that which pertains to fresh water biology. The private library and collections of the head of the department, which contain much material on invertebrate morphology and on parasitism, are also placed at the disposal of graduate students.

Two years of college work in Zoölogy making a total of, at least, sixteen semester hours, are the ordinary preliminary requirements for entering upon graduate study in this department. Under special circumstances advanced work in

closely allied subjects may be accepted in lieu of the fourth semester work in Zoölogy. Even when Zoölogy is chosen for a minor the courses listed for graduates and undergraduates, to be acceptable, must be preceded by at least one full year's undergraduate work in Zoölogy. Work done at other institutions will be valued on conference with the head of the department.

Courses for Graduates

103. Histology of the Nervous System.—A comparative study of the nervous elements of invertebrates and vertebrates with reference to their form, composition, and topographical relations. The evidence for and against the neurone theory of nervous structure is critically considered. Conferences, assigned readings, and laboratory study. *Twice a week; both semesters.* Assistant Professor Carpenter.

107. Parasitology.—The structure and life history of animal parasites, together with their relations to disease. Conferences and assigned readings with laboratory demonstrations. *Two or three times a week; both semesters.* Given in 1912-1913 and in alternate years. Professor Ward.

113. Experimental Zoölogy.—Assigned problems in experimental embryology, regeneration, variation and heredity. The problems are individual and their scope is more or less extended to suit individual needs. *Two to five times per week; both semesters.* Associate Professor Zeleny.

117. Faunistic Zoölogy.—Problems in texonomy, distribution and ecology, accompanied by field work, conference and lectures. The work of this course is favored by a natural history survey of the state now in progress at the University. Students have the advantage of the collections, library, apparatus, and operations of this survey as an aid to their personal studies. *Twice a week; both semesters.*

Associate Professor Smith, Dr. Adams.

127. Theories of Animal Phylogeny.—Relations of various groups of animals; signification of so-called intermediate forms; study of invertebrate larval forms and of theories of descent based on them. Lectures; assigned read-

ings; laboratory. *Once or twice a week; both semesters.* [Given in 1912-13 and alternate years.] Professor WARD.

121. INDIVIDUAL RESEARCH COURSES.—

(a) Zoölogical problems. Professor WARD.

(b) Faunistic and systematic Zoölogy. Associate Professor SMITH.

(c) Animal Ecology and Zoögeography. Dr. ADAMS

(d) Vertebrate Embryology. Assistant Professor CARPENTER

(e) Structure and Development of the Nervous System. Assistant Professor CARPENTER.

(f) Experimental Zoölogy. Associate Professor ZELENY.

Courses for Graduates and Advanced Undergraduates

3. MICROSCOPICAL TECHNIQUE AND GENERAL VERTEBRATE EMBRYOLOGY.—Theory and practice of microscopical technique, followed by the study of vertebrate embryos in early stages of development. In the laboratory the student is first trained in the ordinary methods of fixation, embedding, section cutting, staining and mounting. Embryological material will be prepared and used later in connection with the study of introductory embryology, which completes the course. *Three times a week; first semester.* Associate Professor CARPENTER.

6. VERTEBRATE ORGANOGENY.—A continuation of course 3 intended for medical students and others who desire an intimate acquaintance with the development of the organs of the vertebrate body. The course includes lectures, assigned readings in a textbook of human embryology and laboratory studies on embryos of the chick and pig. *Three times a week; second semester.* Assistant Professor CARPENTER.

7. STRUCTURE OF THE CENTRAL NERVOUS SYSTEM OF VERTEBRATES.—Lectures and demonstrations intended to acquaint the student with the more important anatomical and histological characters of the vertebrate brain and spinal cord. Stress is laid on the grouping of neurones into func-

tional systems with special reference to the higher vertebrates, including man. *Twice a week; first semester.*

Assistant Professor CARPENTER.

9. ANIMAL ECOLOGY.—Introductory study on the relation of animals to their natural environment. Special stress is laid upon the processes of change in environment and their influences upon animal life. Field trips are made for a study of the local fauna and the conditions under which it lives, and for instruction in methods of observations and the making of notes and collections. In the laboratory the specimens are collected and observed and determined, reports are prepared, and a working knowledge of the literature is acquired. Principal attention is given to insects, mollusks, reptiles, amphibians, and fishes. *Three times a week; second semester.*

Dr. ADAMS.

11. PRINICPLES OF ZOOGEOGRAPHY.—An introduction to the study of the geographical distribution of animals, in which particular attention is given to the faunas of North America and of Illinois. The fauna is considered in its relation to the complete environment-climate, physiography, geology, vegetation, etc.,—and from the standpoint of its origin and its dynamic relations; laboratory work on maps, and field excursions. *Two or three times a week; Saturday excursions to be arranged; first semester.* Dr. ADAMS.

13. EXPERIMENTAL EMBRYOLOGY AND REGENERATION.—An analysis of the factors concerned in individual development. Lectures and demonstrations. *Twice a week; first semester.* Associate Professor ZELENY.

13a. EXPERIMENTAL EMBRYOLOGY AND REGENERATION. (Laboratory.)—The application of the experimental method to a definite problem in embryology or regeneration. The work will be individual. *Two to five times a week; both semesters.* Associate Professor ZELENY.

15. VARIATION AND HEREDITY.—An analysis of the facts of variation and heredity with reference (a) to the factors of organic evolution and (b) to the principles of animal breeding. Lectures and demonstrations. *Twice a week; second semester.* Associate Professor ZELENY.

15a. VARIATION AND HEREDITY. (Laboratory.)—The application of the experimental method to a definite problem in

variation or heredity. The work will be individual. *Two to five times a week; both semesters.*

Associate Professor ZELENY.

17. FIELD ZOOLOGY.—The work is planned to give as comprehensive a knowledge as practicable of the animal life of a restricted locality. Collection, preservation and identification of various kinds of animals, together with observations of the habits and life histories of selected forms, constitute the major part of the work. *Three times a week; first semester.*

Associate Professor SMITH.

18. ADVANCED FIELD ZOOLOGY.—A continuation of course 17 providing an opportunity for intensive work on more restricted problems in connection with the local fauna. A taxonomic or distributional problem is studied and the work may be made introductory to subsequent investigation in this field. *Three to five times a week; both semesters.*

Associate Professor SMITH.

20. CURRENT LITERATURE.—The instructors and advanced students of the department meet as a journal club for the presentation and discussion of the results of recent zoölogical investigation. All students doing major work in zoölogy are expected to take active part. *Once a week; both semesters.*

Associate Professor ZELENY and Assistant Professor CARPENTER.

21. INTRODUCTION TO ZOOLOGICAL RESEARCH.—Students looking forward to independent investigation will be assigned definite topics, usually repeating the work of earlier investigators and will be directed in working out the morphology, life history or reciprocal relations of invertebrate forms. Laboratory work with stated conferences and assigned reading. *Two to five times a week; both semesters.*

Professor WARD.

29. ADVANCED ANIMAL ECOLOGY.—A study of special problems in ecology, distribution and faunas, with reference to the interpretations of the relation between animals and their environments. Conferences, laboratory and field work. *Two to five times a week; both semesters.* Dr. ADAMS.

E. Engineering

The degree of Doctor of Philosophy in Engineering is offered in certain lines of academic graduate work of a high scholastic type in engineering science that will attract students who wish to prepare themselves as teachers, investigators and experts.

The general requirements for this degree, as to preliminary education, linguistic attainments, etc., are the same as in other lines.

The following lines of engineering science are open as majors for the present:

Engineering mechanics
Hydraulic and sanitary engineering
Steam engineering
Electrical engineering
Heating and ventilation engineering
Railway engineering
Masonry and structural engineering

The first minor must be one of the following fundamental sciences or an authorized combination of two of them:

Theoretical mechanics
Mathematics
Thermodynamics
Chemistry
Physics (Experimental or mathematical)
Zoölogy
Botany

The second minor should be in other than engineering subjects.

ARCHITECTURE

Registration in graduate courses in architecture presupposes full undergraduate work in the subject or group of subjects chosen.

Courses for Graduates

101. Architectural Construction.—Design of special structures. *Two to six times a week; both semesters.*
Professors Ricker and White.

102. Sanitation of Buildings.—The planning of sanitation, warming, and ventilation, for buildings of importance. *Two or three times a week; first or second semester.*

103. Advanced Architectural Graphics.—Advanced work in graphic statics, stereotomy, perspective, water color, and freehand drawing. *Two or three times a week; first or second semester.* Professors Mann, Ricker and Wells.

104. Architectural Design.—Advanced architectural design. *Six times a week; first or second semester.*
Professor Mann.

105. Architectural Practice.—Contracts, specifications, and office methods. A study of architectural jurisprudence. *Two or three times a week; first or second semester.*
Professor Mann,

106. Architectural History.—Research on special topics. such as: Sources and evolution of architectural forms; origin, development and geographical distribution of architectural styles; effects of function on architectural forms; bibliographical and chronological research. *Two to six times a week; first or second semester.* Professors Mann and Ricker.

CIVIL ENGINEERING

Registration in graduate courses in Civil Engineering presupposes full undergraduate work in the subject or group of subjects chosen.

Courses for Graduates

106. Reinforced Concrete Design.—A study of specifications for reinforced-concrete design in the light of modern tests. The design of concrete forms. The design of typical reinforced-concrete structures. Methods and costs of reinforced-concrete construction. *Three times a week; both semesters.* Professor Talbot.

107. Bridge Engineering.—Theorems of Castigliano; Maxwell's reciprocal theorem; virtual velocities; deflections; camber; redundant members; special graphic methods; secondary systems; impact; general flexure; specifications; tension members; compression members; details of construction; manufacturing methods and costs; bridge erection. *Three times a week; both semesters.* Assistant Professor Dufour.

124. Steel Building Construction.—The design of steel framing of fireproof office buildings, hotels, and industrial buildings; design of steel buildings for industrial purposes; theory of wind bracing; long columns; eccentrically loaded columns; eccentric connections; spandrel bracing; details; braced bents; erection methods and costs. *Three times a week; both semesters.* Assistant Professor Malcolm.

ELECTRICAL ENGINEERING

Registration in graduate courses in electrical engineering presupposes full undergraduate work in the subject or group of subjects chosen.

Courses for Graduates

101. Advanced Course in Alternating Currents.—A study of polyphase circuits, alternating current machinery, alternating current measuring apparatus, or a combination of these subjects. *Twice a week; both semesters.*
Professors Berg and Brooks.

103. Electrical Design.—The development of plans for an electrical machine or apparatus of special character, or for the arrangement of an electrical plant, or for the installation of such machinery or apparatus. *Twice a week; second semester.* Professor Berg, Assistant Professor Waldo.

104. Telegraphy and Telephony.—*Twice a week; second semester.* Professor Brooks, Assistant Professor Paine.

105. Electrical Engineering Research.—An experimental investigation of some electrical phenomena, or tests of some electrical machine, or of a plant of such machines. *Twice a week; both semesters.*
Professor Berg, Assistant Professor Bryant.

106. Illumination.—*Once a week; both semesters.*
Professor Brooks, Assistant Professor Bryant.

Courses for Graduates and Advanced Undergraduates

14. Alternating Currents.—*Four times a week; first semester.*
Professor Berg, Assistant Professors Paine and Bryant.

17. Advanced Alternating Currents.—*Four times a week; second semester.*
Professor Berg, Assistant Professors Paine and Bryant.

27. Electrical Engineering Laboratory.—*Twice a week; second semester.* Assistant Professor Bryant.

MECHANICAL ENGINEERING

Registration in graduate courses in mechanical engineering presupposes full undergraduate work in the subject or group of subjects chosen.

Courses for Graduates

106. Heat Motors.—The advanced theory of the internal combustion motor, and of the steam turbine; the general principles and methods of refrigeration. *Twice a week; second semester.* Proferssor Goodenough.

107. Thermodynamics.—The general principles of thermodynamics and their application to the solution of engineering problems. *Twice a week; first semester.*
Professor Goodenough.

109. Machine Design.—The general principles of rational design; the application of mechanics of materials. Individual problems. *Twice a week; either semester.*
Professor Leutwiler.

112. Laboratory Investigations.—Special investigations of problems relating to the combustion of fuels; boiler economy; steam engines and turbines; gas engines and producers; properties of explosion mixtures; mechanical refrigeration. Original work. *Three times a week; both semesters.*
Professor Richards and Assistant Professor Snodgrass.

114. Dynamics of Machinery.—Advanced problems; whirling and vibration of shafts; theory of governors; fly

wheels; force and mass reduction; stresses in rotating masses. *Twice a week; both semesters.* Professor GOODENOUGH.

Courses for Graduates and Advanced Undergraduates

The following are acceptable as minor courses for students who are not candidates for advanced degrees in mechanical engineering:

6. HEAT ENGINES.—The steam engine; steam turbine; gas engine; air compressor; refrigerating machine. Mixtures of gases; combustion of gaseous fuels. (A continuation of course 7). *Twice a week; both semesters.*

Professor RICHARDS and Professor GOODENOUGH.

7. THERMODYNAMICS.—The transformation of heat into work; the second law and its connection with irreversible processes. the properties of heat media, the perfect gases, saturated and superheated vapors; the flow of fluids. *Three times a week; second semester.* Professor GOODENOUGH.

8. MECHANICS OF MACHINERY.—Friction in machine parts; useful application of friction as in friction clutches and brakes; transmission of power by ropes and belting; brakes, clutches and dynamometers; hoisting machinery; hoisting in mines; elevators and cranes; hydraulic machinery; accumulators, and centrifugal pumps; fans, blowers, air compressors, air motors and transmission of power by means of air. *Three times a week; first semester.*

Assistant Professor LEUTWILER.

9. MACHINE DESIGN.—Theory of machine design, with applications; investigation of actual machines similar to the one to be designed; design of machinery subjected to heavy and variable stresses; punches, shears, presses, riveters, and cranes. *Three times a week; both semesters.*

Assistant Professor LEUTWILER.

12. MECHANICAL ENGINEERING LABORATORY.—Experiments on engines, turbines, gas engines, pumps, boilers, injectors, air compressors, hoisting appliances, heating apparatus, and refrigerating machines. Tests of power plants in the vicinity. *Three times a week; first semester.*

Assistant Professor SNODGRASS.

MECHANICS, THEORETICAL AND APPLIED

Registration in graduate courses in theoretical and applied mechanics presupposes full undergraduate work in the subject or group of subjects chosen,

Courses for Graduates

101. Analytical Mechanics.—The fundamental premises of mechanics; methods of treatment and attack; the more complex problems and applications; a critical and comparative study of texts. *Twice a week; first semester.*

Assistant Professor Moore.

102. Resistance of Materials.—Advanced work on the properties of materials used in engineering construction and the methods of determining these properties; analysis and investigation in mechanics of materials, including the effect of form of member in a structure or machine and the method of application of forces. Comparative study of texts may be made. *Twice a week; second semester*

Assistant Professor Moore.

103. Hydraulics and Hydraulic Engineering.—The laws of hydraulics and their application to engineering problems; hydraulic power and its development; design and investigation. *Twice a week; second semester.*

Professor Talbot, Assistant Professor Moore.

104. Experimental Work in Laboratory of Applied Mechanics.—(a) Laboratory investigation in the materials testing laboratory on materials and on their action as used in machines and structures; (b) experimental work in hydraulic laboratory with pumps, motors, and measuring devices, and the investigation of the laws of hydraulics, the development of power, and the study of various hydraulic problems. *Twice a week; both semesters.* Professor Talbot, Assistant Professor Moore.

105. Experimental and Analytical Work in Reinforced Concrete.—Research work in reinforced concrete. The interpretation of available experimental results and their application to the design of structure. The principles of construction and a study of typical reinforced concrete structures. *Twice a week; both semesters.* Professor Talbot.

MINING ENGINEERING

Registration in graduate courses in mining engineering presupposes full graduate work in the subject or group of subjects chosen.

The laboratory connected with the extended investigation of mining conditions in Illinois now being carried on by the Department of Mining Engineering, the State Geological Survey and the United States Bureau of Mines, together with the Mine Rescue Station operated by the same parties, are available for graduate instruction in addition to the regular University laboratories.

Courses for Graduates

101. Advanced Coal Mining.—Including a study of the coal fields of the United States, and the methods of mining in the same, also the economies of coal mining, including the utilization, marketing, storage and transportation of coal. *Twice a week; both semester.* Professor Stoek.

102. Advanced Preparation of Coal and Ores.—*Twice a week; both semesters.* Dr. Lincoln.

Courses for Graduates and Advanced Udergaduates

5. Mine Ventilation and Mine Gases. Professor Stoek.
6. Mechanical Engineering of Mines. Dr. Lincoln.
9. Preparation of Coal and Ores. Dr. Lincoln.

MUNICIPAL AND SANITARY ENGINEERING

Entrance upon graduate work in municipal and sanitary engineering presupposes a full undergraduate course in that subject.

Courses for Graduates

102. Water Supply Engineering.—Advanced work in water supply engineering will be arranged to fit the conditions

of individual classes. Sources and requirements of water supply, general water works construction, pumps and pumping, design of reservoirs and elevated tanks, and water works operation and the valuation of plants are among the topics which may be treated. *One to three times a week; first or second semester.* Professor TALBOT.

103. SEWERAGE. General sewerage design and construction, a study of sewerage systems, hydraulics of sewers, and a study of run-off, are examples of the work which may be taken up. *One or twice a week; second semester.* Professor TALBOT.

106. WATER PURIFICATION, SEWAGE DISPOSAL AND GENERAL SANITATION.—The design, construction, and operation of water purification plants and of sewage disposal works, the study of existing plants, comparison of results and cost of construction and operation may be taken up in this course. Experimental work on water filters, septic tanks, etc., may be included. Garbage disposal and general sanitation may also be taken. *Once a week; seond semester.* Professor TALBOT.

RAILWAY ENGINEERING

Registration in graduate courses in railway engineering presupposes full undergraduate work in the subject or group of subjects chosen.

The equipment of the department of railway engineering includes a dynamometer car designed for train resistance and locomotive tests on steam roads, and an electric test-car for similar work on electric lines. The department owns also a drop testing machine and a brakeshoe testing machine, which conform, in their design, to the standards of the Master Car Builders' Association.

Courses for Graduates

102. LOCOMOTIVE DESIGN.—Study and analysis of modern practice concerning steam pressure, compounding, superheating, etc. The work in this course may be arranged to suit special requirements of the individual student. *Once a week; both semesters.* Professor GOSS.

106. Locomotive Operation.—Study and determination of train resistance and locomotive tractive effort. The application of these and other matters in the establishment of tonnage ratings. *Once a week; both semesters.* Prof. Schmidt.

108. Electric Railways.—This course deals with the design, selection, and operation of electric railway equipment. Central station, sub-station, rolling stock, and line equipment are considered. The emphasis is put upon either design or operation according to the training and purpose of the student. *Once a week; both semesters.* Assistant Professor Buck.

110. Railway Location.—This course is essentially a study of the effects of the location of a railway upon its earning capacity. It deals with the engineering and economic problems met with in original location, as well as in the relocation and reduction of grades of existing lines. *Once a week; both semesters.* Mr. Foote.

Courses for Graduates and Advanced Undergraduates

4. Locomotive Performance.—*Twice a week; first semester.* Professor Schmidt.

33. Economic Theory of Railway Location.—*Four times a week; first semester.* Mr. Foote.

64. Electric Railway Practice.—*Three times a week; first semester.* Assistant Professor Buck.

65. Electric Railway Practice.—*Three times a week; second semester.* Assistant Professor Buck.

F. Agriculture

AGRONOMY

Students who wish to do their major work in agronomy must have had the major courses offered in that subject to undergraduates in the college of agriculture of the University of Illinois, or the equivalent. While every one seeking a doctor's degree with agronomy as a major will be required to have a good knowledge of the whole field of agronomy, each student is expected to be especially prepared in some of the following

divisions of the field: Soil fertility, plant breeding, soil physics, crop production and soil biology.

Students who are taking their major work in other departments and choose agronomy as a minor, must have had previously the work in chemistry, botany and other fundamental sciences prescribed for the undergraduate courses in agronomy in the college of agriculture, or the equivalent.

Courses for Graduates

101. Soil Investigation.—A study of systems of soil investigation; sources of error and methods of control; interpretation of results. *Once a week; second semester.*
Professor Hopkins.

103. Soil History.—Different systems of agricultural practice and their ultimate effect upon the soil. *Once a week; second semester.* Professor Hopkins.

112. Plant Breeding.—This course includes a detailed study of experiments at this station, and of methods and results reported from other states and from foreign countries. *Twice a week; both semesters.* Professor Smith.

118. Investigation.—A special problem is chosen and worked out under the advice and direction of the instructor. *One to five times a week; both semesters.*
Professors Hopkins, Smith, Mosier, Pettit.

Courses for Graduates and Advanced Undergraduates

9. Soil Physics And Management.—Origin of soil material; methods of formation; mechanical composition and classification; moisture; texture as affecting capillarity, osmosis, diffusion, temperature, aeration, etc. *Five times a week; first semester.* Professor Mosier, Mr. Gustafson.

11. Soil Biology.—Activities of infusoria, fungi, algæ, and bacteria in soils from the standpoint of soil fertility; fermentation of crop residues and green and farm manures and its effect upon insoluble plant food; fixation of atmospheric nitrogen, its transformations, use, and possible losses. *Three times a week; second semester.* Professor Pettit.

12. Soil Fertility, Fertilizers, Rotation.—The influence of fertility, natural or supplied, upon the yield of various crops; effect of different crops upon the soil and upon succeeding crops, etc. *Five times a week; second semester.*
Professor Hopkins, Mr. Fisher.

16. German Agricultural Readings.—The current numbers of German journals on agricultural science are required as a text. *Twice a week; second semester.* Prof. Hopkins.

22. Plant Breeding.—The improvement by breeding of field crops, including the grains, grasses, and legumes; the principles and methods of selection with critical studies of results obtained by various investigators. Lectures, assigned readings, demonstrations, and laboratory exercises. *Second semester.* Professor Smith.

23. Plant Food Supplies.—The world's supply of plant food materials, including methods of utilization. *Once a week; second semester.* Professor Pettit.

24. Mechanical Composition of Soils.—A study of the mechanical composition of the soil and its influence upon granulation, absorption and retention of moisture, and other physical properties affecting crop production. *Arrange time; first semester.* Professor Mosier.

ANIMAL HUSBANDRY

Students entering graduate work in Animal Husbandry must have had a thorough training in the fundamental principles of the subject either in connection with or in addition to an agricultural course of study substantially equivalent to that offered in this University.

Courses for Graduates

103. Live Stock Experimentation.—Objects, methods and the sources of error in experimental work dealing with the feeding, breeding and management of farm animals. Critical study of live stock experiments at this and other experiment stations. *Once a week; both semesters.*
Professor Mumford.

110. Animal Nutrition.—The course includes a thorough study of the chemical and physiological changes and processes involved in the activities of animal life. *Three times a week; both semesters.* [Not given 1912-13.] Professor Grindley.

111. Animal Nutrition.—A study of methods employed in the examination and analysis of feeding stuffs; also animal substances including flesh, fat, bone, urine, feces, and manufactured animal products. *Two to five times a week; both semesters.* Professor Grindley.

112. Investigation.—Opportunity is afforded to pursue investigations along the following lines:

(a) Economic Factors Involved in the Various Phases of Meat Production.

(b) Systems of Live Stock Farming.

(c) The Valuation of Pedigrees a, b and c. *Once a week; both semesters.* Professor Mumford.

(d) Animal Nutrition. A research course in Animal Nutrition including digestion and metabolism experiments and biochemical studies connected with the nutrition of farm animals. *Five times a week; both semesters.* Professor Grindley.

116. Seminar.—A topic is selected on which reports are made and opportunity afforded for discussion. *Arrange time; both semesters.* Professors Mumford, Grindley and others.

Courses for Graduates and Advanced Undergraduates

7. Principles of Animal Nutrition.—*Five times a week; first semester.* Professor Grindley.

22. Advanced Stock Judging.—A study of animal conformation with reference to market and show yard form, quality and condition. *Five times a week; second semester.* Various members of the department.

24. Meat.—A study of the influence of type, condition, age, sex and feeds upon the yield and market grade of meat products. *Once a week; second semester.* Assistant Professor Hall.

25. Wool.—A study of the factors affecting the quality, quantity, strength, and condition of wool. *Once a week; second semester.* Assistant Professor Coffey.

26. Swine.—The factors of Animal Nutrition that have to do with the large and economical production of pork and the determination of type in swine. *Once a week; second semester.* Assistant Professor Dietrich.

27. Sheep Husbandry.—Dealing with the factors determining the importance of the industry in leading sheep growing countries and particularly in different parts of the United States. Assistant Professor Coffey.

DAIRY HUSBANDRY

In Dairy Husbandry graduate work is offered in economic milk production, dairy manufactures, and special problems in the feeding of dairy cattle. Entrance upon work in any one of these lines requires at least ten hours' credit along the line the student desires to follow.

Courses for Graduates

101. Economic Milk Production.—A study of differences in the efficiency of dairy cows, cause and effect of the same, and the relation they bear to successful dairy farming. *Twice a week; both semesters.* Professor Fraser.

102. Research.—A study of the investigations in progress in the dairy herds of the state. *Twice a week; both semesters.* Professor Fraser.

103. Research.—Dairy feeding problems. *Twice a week; both semesters.* Professor Fraser.

Courses for Graduates and Advanced Undergraduates

7. Factory Management.—Problems in the manufacture of butter and cheese; private and co-operative management of creameries and cheese factories; locating, planning, building, equipping, and operating plants; sanitation and products. *Three times a week; second half of second semester.* Mr. Hepburn, Mr. Lang.

11. Dairy Bacteriology.—The relation of bacteria to the dairy industry. Methods of determining the bacterial content

of milk; detection of pus and pus-producing organisms; the relation of bacteria to the changes that take place in the milk; the effect of methods of handling and of temperature upon the bacterial content of milk; the part that bacteria play in the manufacture of butter and cheese. *Five times a week; second half of second semester.* Associate Professor RICKARDS.

21. ECONOMIC MILK PRODUCTION.—*Five times a week; second semester.* Professor FRASER. MR. BRAND

HORTICULTURE

At least twenty hours of undergraduate work in horticulture and sufficient preparation in botany and allied subjects to enable the student to pursue profitably the chosen line of work, are required for entrance upon major work in this department. Minor work may be undertaken by persons who have had sufficient training either in horticulture or in the sciences fundamental to horticulture to enable them to pursue profitably the given line of work.

Courses for Graduates

101. POMOLOGY.—Studies of special problems regarding the relationship, adaptions and improvement of orchard fruits. *Once a week; both semesters.* Professors BLAIR and CRANDALL.

102. POMOLOGY.—Studies of special problems regarding the adaptions and improvement of small fruits. *Twice a week; second semester.* Professor CRANDALL.

103. OLERICULTURE.—Studies of special problems regarding the structure, cultural requirements, and improvement of vegetables. *Once a week; both semesters.* Professor LLOYD.

105. FLORICULTURE.—Special problems in the culture of greenhouse plants. Assistant Professor DORNER.

Courses for Graduates and Advanced Undergraduates

8. ORCHARDING.—A comprehensive study of pomaceous fruits (apple, pear, quince,) and drupaceous or stone fruits (plum, cherry, peach, nectarine, apricot). *Five times a week; second semester.* Professor CRANDALL.

12. EVOLUTION OF HORTICULTURAL PLANTS.—History, botanical classification, and geographical distribution of culti-

vated plants; modification under culture; theoretical causes and observed factors that influence variation, particularly food supply, climate and cross-fertilization. *Five times a week; second half of first semester.* Professor CRANDALL.

18. EXPERIMENTAL HORTICULTURE.—Methods and difficulties in horticultural investigations; the planning of experiments; recording and interpretation of results. (For advanced students preparing for experiment station work). *Five times a week; second semester.*

Professors BLAIR, LLOYD, CRANDALL.

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THE GRADUATE SCHOOL

OF THE

UNIVERSITY OF ILLINOIS

ANNOUNCEMENT FOR

1913—1914

URBANA-CHAMPAIGN, ILLINOIS
PUBLISHED BY THE UNIVERSITY

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THE UNIVERSITY CALENDAR, 1913-1914

As applicable to the Graduate School

First Semester, 1913-1914

1913	
Sept. 22, 23, Monday and Tuesday	Registration days
Sept. 24, Wednesday, 8 a. m.	Instruction begins
Nov. 3, Monday	Latest day for submission to Dean of all thesis subjects as approved by heads of departments
Nov. 26, Wednesday, 12 m.	Thanksgiving recess begins
Dec. 2, Tuesday	Illinois Day, half holiday
Dec. 19, Friday, 5 p. m.	Christmas Holiday recess begins
Dec. 31, Wednesday, 5 p. m.	Latest date for submission of outlines of theses by candidates for professional degrees in engineering
1914	
Jan. 5, Monday, 12 m.	Instruction resumed
Jan. 9, Thursday, 8 a. m.	Semester examinations begin

Second Semester, 1913-1914

Feb. 9, 10, Monday and Tuesday	Registration days
Feb. 11, Wednesday, 8 a. m.	Instruction begins
Feb. 12, Thursday	Lincoln Day
April 9, Thursday, 12 m.	Easter recess begins
April 14, Tuesday, 12 m.	Instruction resumed
April 15, Wednesday, 5, p. m	Latest date for filing with Engineering Committee completed theses by candidates for professional degrees in engineering

May 6, Saturday, 12 m.	Latest date for receipt by Dean of certified doctors' theses
June 4, Thursday	Semester examinations begin
June 6, Saturday, 12 m.	Latest time for receipt by Dean of certified masters' theses
June 14, Sunday	Baccalaureate day
June 16, Tuesday	Alumni day
June 17, Wednesday	Forty-third annual commencement

THE EXECUTIVE FACULTY

EDMUND JANES JAMES, PH. D., LL. D., PRESIDENT OF THE UNIVERSITY.

DAVID KINLEY, PH. D. LL. D., *Dean and Professor of Economics.*

ALBERT PRUDEN CARMAN, A. M., SC. D., *Professor of Physics.*

JULIUS GOEBEL, PH. D., *Professor of Germanic Languages,*

HENRY BALDWIN WARD, PH. D., *Professor of Zoology.*

ARTHUR NEWELL TALBOT, C. E., *Professor of Municipal and Sanitary Engineering.*

STUART PRATT SHERMAN, PH. D., *Associate Professor of English.*

BOYD HENRY BODE, PH. D., *Professor of Philosophy.*

HERBERT WINSOR MUMFORD, B. S., *Professor of Animal Husbandry.*

WILLIAM ABBOTT OLDFATHER, PH. D., *Associate Professor of Classics.*

SAMUEL WILSON PARR, M. S., *Professor of Applied Chemistry.*

EVARTS BOUTELL GREENE, PH. D., *Professor of History.*

EDGAR JEROME TOWNSEND, PH. D., *Professor of Mathematics.*

HISTORY AND ORGANIZATION

Although for many years the University of Illinois had offered advanced students facilities for study and research in various lines, graduate work was undertaken under the name of the Graduate School for the first time in 1892. In 1894 the administration of the school was vested in the Council of Adminstration and the Vice-President of the University became Dean of the School. In 1906 the Graduate School was organized as a separate faculty, consisting of a dean and members of the University faculty assigned to this duty by the President. No means of support were provided, however, separate from those provided for the undergraduate work. In the winter of 1906-7, the Forty-fifth General Assembly of the State passed an act appropriating $50,000 per year for the support of a Graduate School of Fine Arts and Sciences in the State University. This appropriation has been continued by succeeding Legislatures.

By act of the Trustees the teaching faculty of the Graduate School includes all members of the University faculty who give instruction in courses approved for graduate credit. The affairs of the School, however, are in charge of the executive faculty appointed each year by the President.

ADMISSION

Admission to the Graduate School of the University of Illinois is not admission to candidacy for the master's degree. That is to say, no applicant is admitted unless his previous education has been such that he is fully prepared to undertake work of graduate character, so that, assuming him to have had the specific prerequisites for his major subject, he can expect to get his master's degree in one year. Applicants are not admitted if their previous education is such that, aside from the specific prerequisites for their major study, the performance of the work necessary for attaining the master's degree in one year is impossible or highly improbable. Therefore, for admission to the Graduate School to work for a degree an applicant must hold a first degree either from the University of Illinois or from some other university or college of equivalent standing. Admission to particular graduate

courses or departments may be secured only by those who have had the requisite undergraduate work in those courses or departments.

In order to be enrolled as a member of the Graduate School a student must be doing graduate work. The possession of a first degree does not entitle a student to be enrolled in the Graduate School, if the courses which he is taking are undergraduate.

Students of mature age who do not hold a first degree, but satisfy the dean of the school and the officers of the departments in which they wish to work of their earnestness of purpose and special fitness, may be permitted to take work in the Graduate School without reference to candidacy for a degree. In order to secure this permission, however, a candidate must have had such preliminary preparation for the work he wishes to take up as would justify his admission to the Graduate School as a candidate for a degree if he could meet the other requirements fully.

Application blanks may be secured from the Dean of the Graduate School or from the Registrar of the University.

REGISTRATION

After the student's application for admission has been approved, he receives at the Dean's office a permit to register and also a study blank. This study blank must be filled out with the advice of the professors in charge of the selected work.

The person in charge of the major work of the student becomes his adviser, and, together with those with whom the student is taking first and second minor courses, forms a committee with general supervision over the student's general course of study. The chairman of this committee is expected to follow the student's work and see that he is helped to lay out an intelligently planned course, and to give him such advice as may be necessary concerning his scholastic career.

Each student is required to attend a minimum of four class, lecture, or laboratory, exercises, per week, in the first year of his graduate study; and in no case is he permitted during his course to attend more than twelve per week.

Each first-year student doing full work must take at least four unit courses. A unit course is one which requires ten

hours of time per week through one semester, irrespective of the mode of distribution of that time in class work, laboratory work and private study. Four such courses or their equivalent constitute a full minimum program for one semester, and eight such courses, or their equivalent of graduate grade, constitute the minimum year's work required for a master's degree.

Therefore, registration for full work for the master's degree ordinarily provides for three unit courses, or their equivalent, per semester, in addition to a thesis, the time devoted to the thesis being ordinarily reckoned as equivalent to that for one unit course, or ten hours of time a week. If a student is excused from writing a thesis he must take four unit courses or their equivalent per semester.

Unless otherwise specified by the department concerned, a course for graduates and advanced undergraduates, not open to students below senior grade and counting four or five hours of undergraduate credit, if taken by graduate students, will be treated as a unit course; when counting less than four hours of undergraduate credit, such a course, if taken by graduate students, shall be treated as a half-unit course.

Unless otherwise specified by the department, a course the prerequisites of which are such as to make it possible for juniors or sophomores to be admitted if taken by a graduate student is counted as a half-unit course, or a quarter-unit course, according to the number of hours of undergraduate credit for which the course is given.

Graduate students are permitted under proper circumstances to attend classes as visitors and to elect miscellaneous subjects which do not count toward their degree. Under the authority conferred by the faculty on the Dean no student who is carrying full work as herein described will be permitted by the Dean to visit more than one class or to take more than one miscellaneous subject.

The above regulations concerning the program of studies are laid out primarily for first-year students. Second and third year graduate students fill out their programs irrespective of unit value, according to their needs, under the advice of their instructors. The work of second and third year graduate students is arranged in quantity and character with sole reference to prospective candidacy for a doctor's degree.

Assistants and others on the University staff who undertake to do graduate work are permitted to take an amount of work determined by the terms of their employment. Such a student, applicant for a master's degree, must ordinarily stay though at least two years. In no case will the doctor's degree be conferred upon an applicant otherwise fit in less than four years if he is on the staff in any capacity.

Residence.—Continuous residence and study are required of all members of the Graduate School, unless they are granted leave of absence by the Dean, upon recommendation of the professors in charge of their work, for the purpose of carrying on elsewhere studies or investigation in the line of work for their degrees.

CHARACTER OF GRADUATE WORK

The principal aim of graduate study is the development of the power of independent work and the promotion of the spirit of research. Each candidate for a degree is expected to have a wide knowledge of his subject and of related fields of work; for the graduate student is not expected to get from lecture and laboratory courses all the knowledge and training necessary to meet the requirements for his degree.

Students are warned against restricting themselves merely to the courses prescribed or suggested by the departments in which they are studying. Each student is expected to do a wide range of private reading and study, and in many cases will find it advisable to take one or more courses of lectures quite outside the field of his chosen subject.

THE MASTER'S DEGREES

Candidates for the degree of Master of Arts or Master of Science are required to do at least one year's work in residence and to write a thesis.

A candidate for a master's degree may do all his work in one subject, or he may select a major and one minor, or a major and two minors. A major or minor denotes the field of knowledge of a department, or such part thereof as constitutes a separate and independent division of that field. The candidate must do at least half his work in his major subject.

Each candidate for a master's degree is also required to present a thesis on some subject approved by the professor

in charge of his major work and the faculty of the School. The requirement of a thesis may be waived, however, upon the recommendation of the head of the department in which the student is doing his major work, and the approval of the Dean, provided application to waive the thesis is made at the beginning of the year. *In no case will permission to take the degree without the thesis be given if applied for later than latest date for the approval of thesis subjects, as shown by the the calendar.*

The thesis required from a candidate for a master's degree ordinarily will demand about one-fourth of the student's time. The thesis must be type-written, on "thesis paper," and the title-page must be printed. The thesis in its final form, together with a certificate of approval by the proper officer, must be left by the professor in charge at the Dean's office at the time set in the calendar.

Credit for work done elsewhere is not "transferred." The candidate is examaned here on all the work required for the degree.

Students should uote, morever, that all the work for the master's degree must be done in residence, excepting in the case of members of the staff who have spent part of their time in study through a year at some other institution, and then do the rest of the work required during a year's residence here.

The Master's Degree in Engineering

Two classes of second degrees are open to graduates of the College of Engineering, namely, academic and professional.

The academic second degree in engineering is Master of Science, following Bachelor of Science, in Architecture, Architectural Engineering, Civil Engineering, Electrical Engineering, etc. This degree is conferred in accordance with the regulations described above for *academic work in residence only.*

The *professional* second degrees in Engineering are as follows:

Master of Architecture after B. S. in Architecture.

Architectural Engineer after B. S. in Architectural Engineering.

Civil Engineer after B. S. in Civil Engineering or B. S. in Municipal and Sanitary Engineering.

Electrical Engineer after B. S. in Electrical Engineering.

Mechanical Engineer after B. S. in Mechanical Engineering.

Civil Engineer, Electrical Engineer or Mechanical Engineer, after B. S. in Railway Engineering, according to the course.

Professional degrees are conferred upon two classes of candidates: 1. Graduates of the College of Engineering of the University of Illinois who have been engaged in acceptable professional work away from the University for a period of not less than three years after receiving the degree of Bachelor of Science. 2. Graduates of the University of Illinois, or of institutions of equal standing, who have been engaged in acceptable professional work in residence at the University for a period of not less than three years after receiving the degree of Bachelor of Science.

In "acceptable professional work" may be included contributions to technical literature, activity in professional societies, investigation of engineering problems, and the teaching of engineering subjects.

A candidate must declare his candidacy and file with the Dean of the College of Engineering, as chairman of the committee in charge, a detailed statement covering his professional study and experience, not later than the first Monday in November preceding the commencement at which he proposes to qualify. Prior to December 31 next succeeding, he must submit for approval an outline of his proposed thesis and he must file his completed thesis not later than April 1. If the statement of professional experience and study and the thesis are accepted, the candidate must present himself at commencement in order to receive the degree.

Candidates for professional engineering degrees who already hold the degree of Master of Science, may qualify for the professional degree after two years of professional work.

A Candidate for a professional engineering degree must pay the incidental fee of twenty-four dollars on being notified that his professional study and experience are accepted as qualifying him to enter as a candidate for the degree. No one will be enrolled as a candidate for the degree at the following commencement who does not pay his fee at this time. When

a candidate for a professional engineering degree has once been accepted and paid his fee, he is eligible to receive the degree at any time within five years, without additional fee, on completion of the requirements; provided, however, that unless he completes the requirements within two years his name will be dropped from the list of candidates and in order to receive the degree within the five-year period he must register once more.

The Degree of Doctor of Philosophy

General Statement of Requirements.—The requirements for the degree of Doctor of Philosophy are a through mastery of a selected field of study, evidence of the power of independent investigation in this field, a broad knowledge of the wider field of study of which this major subject is a part, a general acquaintance with related fields of knowledge and a mastery of all branches of study which are necessary to a full knowledge of the main subject. Each student who is seeking this degree is expected to choose for study and final examination a major subject, or field of study, and a first and second minor. The major subject is the field in which the student expects to become expert and an authority. The first minor must be a subject closely related to the major and, under certain conditions and with proper approval, may be a subdivision of the major field of study. The second minor should be chosen outside of the major field of study.

When a candidate chooses any subject as his major, and a division of that subject as his minor, he is not permitted to choose as a second minor any division of work in that same department, excepting by vote of the executive faculty of the School.

The candidate's list of subjects must receive the approval of the head of the department in which he chooses his major work and of the Dean of the School.

Period of Study.—The *minimum* period of study required for securing the degree of Doctor of Philosophy is three years. The degree is conferred, however, not for residence during a certain period, but for scholarly attainments and power of investigation, as proved by thesis and examinations.

Candidates should note that credit is not given for work done in other universities, excepting in the sense that their

residence at other institutions is counted towards the residence requirement for the doctor's degree.

At least the first two or the last one of the three years required must be spent at this University.

Examination.—Towards the end of his second year of study, or, by special permission, at the beginning of his third year, the candidate for the degree must submit to a preliminary examination conducted by the members of the faculty with whom he is doing his principal work, in order to determine whether he will be accepted as a candidate for the degree in the following year. This examination is partly oral, and may be wholly so. At this time, or before, the candidate will be required to demonstrate his ability to read French and German, and any other language needed for the prosecution of his work.

On or before the last Monday in May of the year in which the candidate expects to come up for his degree, he must submit to a final examination by a committee appointed by the Dean of the Graduate School. This examination will be partly written. The candidate will also have, however, an oral examination. These examinations will not be confined to the courses which the candidate has attended in the University of Illinois only, if he has done part of the work elsewhere; nor even to the field covered by the courses specifically taken in this or other universities; but will be so conducted as to determine whether the candidate has a satisfactory grasp of his major subject as a whole, and a general acquaintance with the fields of knowledge represented by his course of study.

Before the candidate is admitted to the final examination and the defense of his thesis, he may be required to take any other examination, oral or written, that is thought proper by the various departments in which he has studied. If after having passed his preliminary examination, he fails in the third year of his study to meet the expectations of the professors in charge of his work, or in any way fails to maintain the standard of scholarship and power of research expected of him, he may be refused admission to the final examination.

The final examination in the major and minor subjects may not be divided. The examination must be taken all at one time even though it requires several sessions.

Credit for work done in other universities is not "transferred." The candidate is examined here on the subjects offered by him for the advanced degree. However, his period of residence at another institution of proper grade will be accepted as fulfillment of the residence requirement of the University of Illinois so far as it goes.

Thesis.—The power of independent research must be shown by the production of a thesis on some topic connected with the major subject of study. The candidate is expected to defend his thesis or dissertation before the members of the faculty, or as many of them as may wish to question him about it, in connection with his final examination.

The subject of the thesis should be chosen not later than the end of the second year of study and must be submitted for formal approval by the faculty not later than the first Monday of November of the year when the degree is expected. A typewritten copy of the complete thesis, on thesis paper, must be in the hands of the Dean not later than noon of the Saturday nearest the middle of May, for submission to the examining committee.

The doctor's thesis must be printed and one hundred copies deposited in the Library of the University not later than the first of June preceding the conferring of the degree. If it is not printed by the first of June, the student must deposit seventy-five dollars ($75) or a bond for that amount satisfactory to the Comptroller of the University and the Dean of the Graduate School. If a bond is accepted, it must be replaced at the end of one year with a cash deposit. At the end of two years, if the thesis has not then been printed by the student, the University will print such part of it as it deems best.

The cash deposit made by the student who does not print his thesis by the end of the second year after his degree is conferred becomes the property of the University, to be used for the general purpose of printing theses, and all graduate students who receive their degrees must agree at the time when the deposit is made that the University shall become the owner of this deposit for this purpose.

The title page of each thesis must bear the words "Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in—(here put the major subject),

in the Graduate School of the University of Illinois." The title page must also contain the full name of the author, the full title of the thesis, the year of imprint, and, if a reprint, the title, volume and statement of the pagination of the volume from which it is reprinted. Each thesis must have an appendix giving a short biography of the candidate, including the institutions he has attended, his degrees and honors, the titles of his publications, and such other matters as are pertinent.

SCHOLARSHIPS AND FELLOWSHIPS

A number of fellowships and scholarships have been established by the Trustees of the University. To first year graduate students of ability and promise there are open a number of scholarships with a stipend of $250 each and freedom from tuition, incidental and laboratory fees. To second and third year graduate students, that is, those who have had one or two years of graduate study, there are open fellowships with a stipend varying from $300 to $500, with freedom from fees. The larger stipends are given only to students who are expected to take their degrees within the year. Each holder of a fellowship or scholarship must pay the matriculation fee of ten dollars, unless he holds a first degree from the University of Illinois, and also the diploma fee of five dollars on receiving his diploma.

Candidates for these scholarships and fellowships must be graduates of the University of Illinois, or of colleges or universities having equivalent requirements for bachelors' degrees.

Application must be made upon blanks to be obtained from the Dean of the Graduate School. These application forms should be addressed to the Dean of the Graduate School as early as possible in February of the academic year preceding that for which the fellowship is desired.

Persons appointed are required to send the Secretary of the Board of Trustees prompt notice of their acceptance or refusal; and to agree that, if accepted, the appointment will not be resigned to take a similar one in any other institution during the year for which it is awarded.

Nominations to fellowships are made upon the grounds of worthiness of character, scholastic attainments, and promise of success in the principal line of study or research to which the candidate proposes to devote himself.

Scholarships and fellowships are good for one year, but may be renewed for a second or a third year in special cases. An appointment as honorary fellow, without stipend, may be made as specified for paid fellowships in the case of any one who has shown distinguished merit in his work.

Research Fellowships in the Engineering Experiment Station

The Engineering Experiment Station is devoted entirely to research. Its purposes are the elevation of engineering education, and the study of problems of special importance to engineers and to manufacturing, railway, mining, and industrial interests.

Ten research fellowships have been established in the Engineering Experiment Station. These fellowships are open to graduates of approved technical schools and universities, both American and foreign. There is a stipend of $500 a year for each fellowship. Applicants to whom these fellowships are awarded are required to agree to hold them for two years, devoting a part of their time to the work of the Engineering Experiment Station. At the expiration of this period, if all requirements have been met, the degree of Master of Science will be conferred.

Application for these fellowships should be made to the Director of the Engineering Experiment Station not later than February first. Candidates must present with their applications full information concerning themselves, including any written or published papers or results of investigation.

LIBRARIES

The general University library, the library of the State Laboratory of Natural History, that of the Agricultural Experiment Station, and that of the College of Law are all at the University in Urbana. The libraries of the School of Pharmacy and the College of Medicine are in Chicago.

The general University library contains 240,000 volumes and 50,000 pamphlets. The University has a subscription list of 1,300 periodicals. The Library of the State Laboratory of Natural History contains 7,450 volumes and 18,200 pamphlets. The library of the College of Law contains the Federal and State Reports, the leading textbooks, and a line of leading periodicals, aggregating more than 14,000 volumes.

The general library of the University is open daily, from 8 a. m. until 10 p. m. and on Sunday from 2 p. m. to 6 p. m.

The Mason Historical Library—The valuable library of western history collected by Edward G. Mason, Esq., long president of the Chicago Historical Society, is in the Public Library of the city of Champaign, and is accessible to University students.

The Dittenberger Classical Library—The University possesses the library of Wilhelm Dittenberger, at one time Professor of Classical Philology in the University of Halle. This library contains 5,600 items and is especially valuable for the literary study of the classical languages. It includes, in the best editions, the works of the poets and prose writers, both Greek and Latin, and numerous works on grammar and history of literature, with between four and five thousand dissertations and programs on special topics. In addition, there are many works dealing with the other departments of classical philology, as epigraphy, history of ancient peoples, archaeology, philosophy, history of art, geography, chronology, metric, etc.

The Heyne Library of Germanics.—The entire library of Professor Moritz Heyne of the University of Göttingen was bought in 1909. It contains about 5,200 volumes. The collection is rich in the general field of German philology and especially in lexicography. It has many rare first editions of works of German literature from the sixteenth, seventeenth and eighteenth centuries, and has sets of a number of rare periodicals. It is also rich in works upon the history of German civilization.

The Gröber Library in Romance Languages.—The University has recently purchased the library of Professor Gröber of the University of Strassburg. This library contains about 6,500 titles, and, added to what is already in the University library, furnishes somewhat over 10,000 volumes for this field.

Furthermore, notable additions have been made in the past few years to the libraries of the departments of of history, education, economics, English, and political science.

FEES AND EXPENSES

Except as noted below, graduate students pay fees as follows:

Matriculation fee	$10.00
Incidental fee, each semester	12.00
Diploma fee	5.00

All graduate students who have not matriculated as undergraduates at the University of Illinois pay the matriculation fee on entrance.

All graduate students pay the diploma fee on being recommended for their degrees.

No tuition or incidental fee is charged for graduate courses to scholars, fellows, or members of the corps of instruction or the staffs of the scientific bureaus or experiment stations, nor for undergraduate courses on their study lists if approved by the heads of the departments and by the Dean of the School as necessary or desirable for the proper completion of the work for the degree. Otherwise, graduate students who take undergraduate courses must pay the proper undergraduate fee.

Each student working in laboratories, or in the drafting or engineering classes, is required to make a deposit of from 50 cents to $10.00, to pay for chemicals and apparatus used, and for any breakage or damages. But no charges or deposits for laboratory materials are required from scholars, fellows, or members of the corps of instruction or scientific staffs mentioned above.

Table board may be obtained at prices ranging from $4.00 per week.

Room rent, with two in a room, from $2.50 per week.

THE GRADUATE CLUB

The Graduate Club is an unofficial organization of the graduate students and graduate faculty. Its purpose is to furnish an opportunity for those working in different departments to become acquainted with one another and thus counteract the tendency toward narrowness which graduate work often develops.

DEPARTMENTS OF INSTRUCTION

Courses are offered in the following groups of subjects:

A. Language and Literature.
B. History and the Social Sciences.
C. Education, Philosophy and Psychology.
D. The Sciences, including Mathematics.
E. Engineering.
F. Agriculture.

A. Language and Literature

THE CLASSICS

The Degree of Master of Arts in Classics.—The major may be in either Latin or Greek, but every candidate for a degree should take work in both languages.

Each candidate must also pass two examinations before the period of the regular course examinations of the second semester, which are to be regarded as tests of attainment, rather than as imposing any requirement of special or additional preparation. The first examination will consist of written translation at sight from the candidate's major language of passages equivalent in difficulty to the translation work of first-year graduate courses. The second examination will be oral and designed to reveal the candidate's general ability and his advancement in the various fields of classical philology, especially those treated in the Classical Proseminary.

The Degree of Doctor of Philosophy in Classics.—The following features of the special departmental requirements for this degree may be noted here: the degree is given in Classical Philology, major work may be taken in either Latin or Greek, but whichever language is taken as the major, the other must be taken as the first minor.

GREEK

Preparation for first-year graduate work in Greek must include two years of college Greek in addition to entrance requirements, and three years of college Latin. A reading knowledge of German or French, preferably the former, is highly desirable for candidates for the Master's degree. The study of History and Philosophy is especially recommended.

Courses for Graduates

104. HOMER AND THE HOMERIC QUESTION.—Lectures and readings in alternate hours. The whole of the Iliad and a large portion of the *Odyssey* will be read. *Twice a week; both semesters. One unit.*

Associate Professor OLDFATHER.

[Alternates with 105. Not given in 1913-14.]

105. PLATO AND ARISTOTLE.—Lectures and reading in alternate hours. Selections from the Republic of Plato and the Ethics of Aristotle. *Twice a week; both semesters. One unit.*

Associate Professor OLDFATHER.

[Alternates with 104.]

106. GREEK DRAMA.—One play of each of the great dramatists will be made the basis of a detailed investigation into the origin and development of dramatic technique, and the history of that phase of Greek literature. In addition to the plays read in class, certain others will be assigned for private reading. *Twice a week; both semesters. One unit.*

Professor MOSS.

107. GREEK ORATORY.—One or more speeches of each of several orators will be read rapidly, and the remainder of the year will be spent on more detailed study of one or two authors, with especial attention to their style, their place in the canon, and their relation to their times. Certain problems in the Athenian constitution and legal practice will be assigned for individual study and report. *Twice a week; both semesters. One unit.*

Professor MOSS.

[Not given in 1913-14.]

LATIN

Students desiring to take first-year graduate work in Latin must have at least three years of college Latin in addition to entrance requirements. A reading knowledge of German or French, preferably the former, is highly desirable for candidates for the master's degree. Some acquaintance with Greek is indispensable for advanced work in Latin. The study of History and Philosophy is especially recommended.

Courses for Graduates

102. Roman Oratory.—A study of the subject in its development as a department of literature, with special reference to the Ciceronian period. *Twice a week; second semester. Half unit.*

Dr. Canter.

103. Cicero.—The De Natura Deorum and the De Divinatione. The Epicurean, Stoic, and Academic Theories of religion and their relation to the popular worship will be considered. *Twice a week; first semester. Half unit.*

Assistant Professor Pease.

104. Latin Palaeography.—Lectures on the material and form of ancient books, the methods of copying, and the common errors in manuscripts. A study of facsimiles of codices of different periods and styles, and practice in the principles of text criticism so far as they are dependent upon palaeography.

Twice a week; first semester. Half unit.

Assistant Professor Pease.

105. A Survey of Latin Poetry.—Lectures on the History and development of Latin poetry. Typical selections from the principal authors and periods treated will be assigned for outside reading and portions will be interpreted in class. *Twice a week; second semester. Half unit.*

Assistant Professor Pease.

[Not given in 1913-14.]

106. Latin Comedy.—The comedies of Terence will be read entire and two or three plays interpreted in class. Lectures on literary history and syntax of early Latin. *Twice a week; first semester. Half unit.*

Associate Professor Oldfather.

107. Latin Epigraphy.—The purpose of this course is to familiarize the student with the forms and language of inscriptions and to read selections from those in the Corpus Inscriptionum Latinarum, especially of such as are important for their content. A short report may be called for. *Twice a week; second semester. Half unit.*

Assistant Professor Pease.

108. Tacitus.—The Histories. Some attention will be given to the style of Tacitus but particular emphasis will be placed upon political and social conditions. *Twice a week; first semester. Half unit.*

Professor Barton.

109. Virgil.—The life and works of Virgil, with study of his sources and of his influence upon later literature. *Twice a week; second semester. Half unit.*

Assistant Professor Pease.

116. Plautus.—Six comedies of Plautus will be read, and two or three interpreted in class. Lectures on literary history and text tradition of Plautus. *Twice a week; first semester. Half unit.*

Associate Professor Oldfather.

[Not given in 1913-14.]

Courses for Graduates and Advanced Undergraduates.

14. Seneca.—Selections from his letters and tragedies. A number of the letters will be read in class, while others will be assigned for outside reading and class interpretation. Two of the tragedies will be read and interpreted. *Three times a week; first semester.*

Professor Barton.

[Not given in 1913-14.]

16. Martial and Suetonius.—Selections and lectures. *Three times a week; second semester.*

Associate Professor Oldfather.

22. Late Latin.—Rapid reading of selections from Latin writers from Minucius Felix to Cassiodorus. This course will be of value to students of the history of the period and to those interested in the earlier patristic literature. It is open to seniors and graduates who have had two years of college Latin

or who otherwise satisfy the instructor of their ability to do the work required. *Twice a week; second semester.*

Assistant Professor PEASE.

CLASSICAL PHILOLOGY

110. PROSEMINAR.—This course is designed to make clear the aims and methods of Classical Philology, to outline the more important divisions of the subject, and to present the main sources of bibliographical material, together with selected bibliographies of certain fields. Attention is given to the preparation of theses for advanced degrees. All graduate students who are taking Latin or Greek as a major for the master's degree must elect this course unless they have already completed it or its equivalent. *Once a week; both semesters. Quarter unit.*

Associate Professor OLDFATHER and Assistant Professor PEASE, assisted by the other members of the department.

101. PRINCIPLES OF COMPARATIVE GRAMMAR.—A general survey of the principles of linguistic science is followed by a systematic study of Greek and Latin sounds and inflections. Attention is also given to the historical development of Latin syntax. *Three times a week; first semester. One unit.*

Dr. CANTER.

This course may be counted for either Latin or Greek credit.

[Not given in 1913-14.]

ENGLISH

Students who enter upon graduate work with English as their major subject are required to give evidence of ability to write well, and of a considerable acquaintance with English literature. They should have had training as undergraduates in the classics, the modern languages, history and philosophy.

A reading knowledge of French and German is from the beginning highly desirable; after the first year it is indispensable.

The Degree of Master of Arts in English.—In addition to complying with the general rules of the Graduate School, candidates for the degree of Master of Arts in English must comply with the following rules of the Department of English:

(1) they must choose a portion of their work from the group of courses described as "for graduates;" (2) must offer an elementary course in Anglo-Saxon; and (3) must take, besides the regular semester examinations in all their courses, a general examination, oral or written as the department may prescribe, which shall be a final test of the candidate's fitness and ability.

The Degree of Doctor of Philosophy in English.—Candidates for the degree of Doctor of Philosophy in English may expect to be examined on the entire field of the English language and literature. They are urged, furthermore, to acquaint themselves as fully as possible with the history and the philosophy of the period in which their main interest lies, and with the foreign language and literature most closely related to English in that period.

Courses for Graduates

101. RESEARCH IN SPECIAL PERIODS.—Competent graduate students are encouraged to seek the advice and assistance of the department of English and to submit to the Department plans for study in the language or literature of the periods mentioned below.

A. Anglo-Saxon Language and Literature.
Professor DODGE and Dr. ZEITLIN.

B. Thirteenth and Fourteenth Centuries.
Assistant Professor JONES.

C. Sixteenth Century.
Professor ALDEN and Professor DODGE.

D. Seventeenth Century.
Professor ALDEN and Assistant Professor BALDWIN.

E. Eighteenth Century.
Professor SHERMAN and Assistant Professor PAUL.

F. Nineteenth Century.
Professor SHERMAN and Associate Professor FULTON.

104. SEMINAR IN LYRICAL POETRY.—Subject: The Religious Lyric in the 17th Century. *Twice a week; second semester. One unit.* Professor ALDEN.

105. SHAKESPEARE'S SONNETS.— A critical study of the text and the problems involved in its interpretation. *Twice a week; first semester. One unit.* Professor ALDEN.

106. English Literary Criticism.—[A. 16th and 17th Centuries. Omitted in 1913-14.] B. 18th Century. *Twice a week; both semesters. One unit.*

Associate Professor Fulton.

109. German and Scandinavian Influences on English Literature of the 18th and 19th Centuries. *Twice a week; first semester. One unit.* Professor Dodge.

110. Old English (Anglo-Saxon) Poetry. *One unit. Twice a week; first semester.*

Professor Dodge.

113. Historical Prose Syntax. [Not given in 1913-1914.] Dr. Zeitlin.

126. Ballads and Metrical Romances. [Not given in 1913-1914.] Assistant Professor Jones.

127. Middle English. Critical reading of Middle English texts. *Twice a week; both semesters. One unit.*

Assistant Professor Jones.

136. The Transition from the 17th to the 18th Century: the Rise of Classicism. *Twice a week; both semesters. One Unit.* Assistant Professor Paul.

137. Prose Writers of the 19th Century. [Not given in 1913-1914.] Professor Sherman.

138. The Romantic Movement in England. *One unit. Twice a week; both semesters.* Professor Sherman.

150. Old Irish. Selections from the glosses and from the Táin bó Cualnge; lectures on Old and Middle Irish literature. [Not given in 1913-1914.] Dr. Shoepperle.

Courses for Graduates and Advanced Undergraduates

A. Literature and Language

3. The Poetry of Milton.—Origins, forms, artistic and ethical values; Milton's place in English literary history. *Twice a week; second semester.* Professor Baldwin.

4. English Versification.—Theory of English rhythm and metre; history of the development of the forms of English verse. *Three times a week; first semester.*

Professor Alden.

5. Shakespeare.—Intensive study of a few plays, with special emphasis on Hamlet. *Three times a week; second semester.* Professor Dodge.

7. Chaucer and His Contemporaries. (The first semester, devoted wholly to Chaucer, may be taken separately.) *Three times a week; both semesters.*

Assistant Professor Jones.

8. Old English (Anglo-Saxon).—Grammar; prose; short poems; *Beowulf.* (The first semester may be taken separately.) *Three times a week; both semesters.*

Professor Dodge.

14. Studies in the History of Journalism. *Twice a week; both semesters.* Assistant Professor Scott.

15. Teachers' Course.—Methods of teaching English literature and composition in the high school. (Either semester may be taken separately. This course, while open to graduate students, is not credited toward advanced degrees.) *Twice a week; both semesters.* Assistant Professor Paul.

18. Modern English Grammar.—The structure of the sentence and its analysis into the parts of speech; the common grammatical categories; the peculiarities of English syntax. *Three times a week; second semester.* Dr. Zeitlin.

35. The English Drama (exclusive of Shakespeare).—A. (first semester), From the beginning to 1600; B. (second semester), From 1660 to 1700. (Either semester may be taken separately.) *Three times a week; both semesters.*

Professor Dodge, Professor Sherman.

38. The Arthurian Tradition in England.—Primitive elements; the historical Arthur; Celtic, French, and Italian influences; the tradition in England from the early romances to Arnold. *Three times a week; second semester.*

Dr. Shoepperle.

39. Introduction to the Literature of the Middle Ages. [Not given in 1913-1914.] Dr. Creek.

45. The Development of the Modern Drama.—Dramatic tendencies in the 18th and 19th centuries, both in England and on the Continent; representative readings, and lectures from the standpoint of comparative literature. *Twice a week; both semesters.* Mr. Guild.

B. Rhetoric

8. Interpretive Reading. (This course, while open to

graduate students, is not credited toward advanced degrees.) *Twice a week; second semester.* Mr. GUILD.

15. ADVANCED NEWSPAPER WRITING.—The larger problems in reporting; application of principles of history, economics, and political science to current public events; editing; editorial writing. *Three times a week; both semesters.* Assistant Professor SCOTT.

17. ADVANCED COMPOSITION.—Practice writing, with special emphasis on the study of structure; criticism of current periodical literature; the development of material for reports, magazine articles, etc. (Open to a limited number of students, and only on recommendation.) *Three times a week; second semester.* Mr. GUILD.

GERMANIC LANGUAGES

GERMAN

Students desiring to take German as a major are expected to have finished successfully a four years' course of undergraduate work in German, corresponding to the four years' course in German at this University. They are expected to be familiar with the principal works of the writers of the classical and modern periods of German literature, to show a general knowledge of the history of German literature and to be able to follow lectures in the German language.

Of collateral subjects, a reading knowledge of Latin and French is required. It is desirable that candidates for the degree of Ph. D. have some knowledge of Greek. All students are expected to have had a course in German History.

Courses for Graduates

101. SEMINAR IN GERMANIC PHILOLOGY.—The work is adapted to the abilities and tendencies of the students. The primary object is to give training in original research. The result of the work, when of value, may be published in the *Journal of English and Germanic Philology. Once a week; both semesters. One unit.* Professor GOEBEL.

103. INTRODUCTION TO THE HISTORICAL STUDY OF THE GERMANIC LANGUAGES.—Lectures; discussion of special topics; History of German Philology. Comparative Grammar of the Old Germanic dialects. *Twice a week; second semester. One unit.* Professor GOEBEL.

104. GOTHIC.—An introductory study of its grammar and literature. *Twice a week; first semester. One unit.*

Professor GOEBEL.

105. OLD HIGH GERMAN.—Grammar and interpretation of the oldest literary documents. *Three times a week; second semester. One unit.* [Not given 1913-1914.]

Dr. BLOOMFIELD.

109. GOETHE'S AND SCHILLER'S PHILOSOPHY.—*Twice a week; both semesters. One unit.* [Not given 1913-1914.]

Professor GOEBEL.

110. EARLY GERMAN DRAMA.—The development of the German drama up to the Reformation, including the medieval religious drama, the Shrovetide plays and the beginnings of the Humanistic drama. *Twice a week; first semester. One unit.* Assistant Professor BROOKS.

113. GERMAN LITERATURE OF THE FIFTEENTH AND SIXTEENTH CENTURIES.—Survey of the literature on the background of the general history of the time. Luther and the Reformation, Mastersingers and Folksong, the Reformation drama, Hans Sachs, Brant, Fischart, the chap books, the English comedians. *Twice a week; second semester. One unit.* Assistant Professor BROOKS.

115. HISTORY OF GERMAN LITERATURE FROM GOETHE'S DEATH TO THE PRESENT TIME. *Twice a week; both semesters. One unit.* Associate Professor LESSING.

116. MEDIEVAL GERMAN LITERATURE WITH REFERENCE TO THE POLITICAL, RELIGIOUS, AND SOCIAL HISTORY.—Research course. *Twice a week; both semesters. One unit.*

Associate Professor LESSING.

117. HISTORY OF GERMAN LITERATURE DURING THE EIGHTEENTH CENTURY.—*Twice a week; both semesters. One unit.* Professor GOEBEL.

118. THE GERMAN DRAMA SINCE SCHILLER.—Research course. *Twice a week; both semesters. One unit.*

Associate Professor LESSING.

119. THE GERMAN NOVEL.—Research course. *Twice a week; both semesters. One unit.* Associate Professor LESSING.

121. WALTHER VON DER VOGELWEIDE.—Lectures and interpretations. *Twice a week; second semester. One unit.*

Professor GOEBEL.

124. History of the Drama. The beginnings of the drama and its development in the eighteenth century. *Twice a week; first semester. One unit.*

Assistant Professor Meyer.

[Not given in 1913-1914.]

Courses for Graduates and Advanced Undergraduates

8. Schiller.—The life of Schiller; *Wallenstein* and other selections. *Three times a week; first semester. Half unit.* Associate Professor Lessing.

9a. Goethe's Faust.—The Faust legend and early Faust books and plays; the genesis of Goethe's *Faust;* reading of both parts. *Twice a week; both semesters.* Professor Goebel.

9b. Goethe-Schiller. — Interpretation of Goethe's poems. Goethe's *Tasso* and Schiller's *Ueber naive und sentimentalische Dichtung. Twice a week; both semesters. Half unit.* [Not given 1913-1914.] Professor Goebel.

11. German Literature after the Reformation.—Lectures; recitations; reports on assigned reading. *Three times a week; second semester.* Associate Professor Lessing.

25. Teacher's Course.—Discussion of methods; examination of text-books. *Twice a week; second semester. Quarter unit.* Assistant Professor Brooks.

26. German Literature before the Reformation.—Lectures; recitations; reports on assigned reading. *Three times a week; first semester. Half unit.*

Associate Professor Lessing.

27. Lessing. The life of Lessing; *Nathan der Weise, Emilia Gallotti* and other selections. *Three times a week; second semester. Half unit.* Associate Professor Lessing.

29. Advanced Prose Composition. Themes on Germany and German life, based on suitable reading, discussed in German. *Three times a week; both semesters.* Dr. Koller.

31. Middle High German.—Grammar and readings. *Twice a week; first semester.* Professor Goebel.

The Scandinavian Languages

Preparation for graduate work in the Scandinavian languages or literature must include a reading knowledge of one of the Scandinavian languages and systematic work in the undergraduate courses in Scandinavian or their equivalent.

Any graduate student in language may, however, be admitted to the purely philological courses.

Courses for Graduates

101. Old Norse.—Introduction to the language as a member of the Germanic group. Reading of the *Volsungasaga* with selections from the King's Sagas. *Both semesters.* Assistant Professor Flom.

103. Old Swedish.—Introduction to the language. Noreen's *Altschwedische Grammatik* and *Lesebuch.*

Assistant Professor Flom.

110. Advanced Old Norse.—Mythical lays of the *Elder Edda. Twice a week; first semester.*

Assistant Professor Flom.

130. The Runic Inscriptions.—Lectures on the runes and the interpretation of the Germanic and Scandinavian inscriptions; Germanic grammar. *Twice a week; second semester.* Assistant Professor Flom.

150. Research. Special problems.

Assistant Professor Flom.

Courses for Graduates and Advanced Undergraduates

11. Survey of the History of the Swedish Language and Literature.—Lectures. Assistant Professor Flom.

ROMANCE LANGUAGES

Before entering upon the study of Romance Languages for an advanced degree, the candidate must have had a total of at least thirty hours of college work in these languages. Eighteen of these hours must be in one of these three languages, French, Italian, or Spanish, but no candidate will be received who has not had at least twelve hours in French. In addition a candidate must have had good training in Latin, and be able to read ordinary German prose.

French

Courses for Graduates

102. Old French Readings. Reading and interpretation of representative masterpieces in Old French literature with emphasis upon Old French syntax. Collateral reading will include other masterpieces and selected chapters in the

history of Old French literature. For such students as may desire it, the collateral work may consist of the elements of Old French phonology and morphology. *Twice a week; both semesters. One unit.* Professor OLIVER.

103. OLD FRENCH PHONOLOGY AND MORPHOLOGY. Development of Old French from Vulgar Latin. *Twice a week; both semesters. One unit.* [Not given in 1913-1914.] Assistant Professor BLONDHEIM.

108. VULGAR LATIN AND MEDIEVAL LATIN. The development of the Latin language from the earliest times to the Carolingian Epoch. Study of medieval paleography. *Twice a week; first semester. One unit.*
[Not given in 1913-1914.] Assistant Professor BECK.

109. HISTORY OF FRENCH LITERATURE IN THE MIDDLE AGES, FROM THE CAROLINGIAN EPOCH TO GUILLAUME DE MACHAULT. Reading of texts. Reports on problems concerning the general culture and civilization of the Middle Ages. *Twice a week; second semester. One unit.*
[Not given in 1913-14.] Assistant Professor BECK.

110. INTRODUCTION TO THE HISTORICAL STUDY OF THE ROMANCE LANGUAGES, ESPECIALLY OF OLD PROVENCAL. Phonology, morphology, syntax, and paleography. *Twice a week; first semester. One unit.* Assistant Professor BECK.

111. HISTORY OF OLD PROVENCAL LITERATURE.—Its origin and its influence on the other Romanic literature. The poetry of the troubadours. Reading of the texts from photographic reproductions and from printed materials with a view to preparing critical editions of such texts. *Twice a week; second semester. One unit.* Assistant Professor BECK.

112. INTRODUCTION TO ROMANCE PHILOLOGY.—Phonology. Special emphasis will be placed upon the problems which confront the teacher of French, Italian, and Spanish. *Once a week: both semesters. One half unit.*
Assistant Professor FITZ-GERALD.

125. SEMINAR. Research work in the field of Old French Literature. *Twice a week; both semesters. One unit.*
[Not given in 1913-1914.] Associate Professor CARNAHAN.

Courses for Graduates and Advanced Undergraduates

10. GENERAL SURVEY OF FRENCH LITERATURE.—An introduction to more extended study of special periods and authors. The main currents of French literature from the

beginning to the present time. *Three times a week; both semesters.*

[Not given in 1913-1914.] Associate Professor CARNAHAN.

23. MODERN FRENCH POETRY. A study of the main principles of declamation and interpretation of French poetry from Rousseau to the present time. Recitations and prosodical analyses of the different categories of such poems. This course is conducted in French. *Three times a week; both semesters.* Assistant Professor BECK.

24. FRENCH LITERATURE OF THE SEVENTEENTH AND EIGHTEENTH CENTURIES.—A study of the greater masterpieces of the seventeenth and eighteenth centuries in France. *Three times a week; both semesters.* Professor OLIVER.

26. FRENCH LITERARY CRITICISM.—After an introduction treating of the history of criticism in antiquity and in the Italian Renaissance, the work of the principal French critics is studied. Special emphasis is laid upon the seventeenth and the nineteenth centuries, in connection with the development of classicism and romanticism. *Twice a week; both semesters.*

[Not given in 1913-1914.] Assistant Professor BLONDHEIM.

SPANISH

Courses for Graduates

121. OLDEST MONUMENTS OF THE SPANISH LANGUAGE.—Historical grammar and paleography. *Once a week; both semesters. One-half unit.* Assistant Professor FITZ-GERALD.

[Not given in 1913-1914.]

125. THE NOVELA OF THE GOLDEN AGE. A study of the political and social conditions in Spain from 1560 to 1700 is followed by an examination of the various kinds of prose fiction produced in this period, with special attention to *Don Quixote* and the *Novelas Exemplares* of Cervantes. *Twice a week; both semesters. One unit.*

Assistant Professor FITZ-GERALD.

Courses for Graduates and Advanced Undergraduates

11. THE SPANISH DRAMA OF THE SIXTEENTH AND SEVENTEENTH CENTURIES. *Encina, Torres Naharro, Lope de Vega, Lope de Rueda, Tirso de Molina, Calderon, Ruiz de Alarcon,*

Moreto, Rojas Zorilla; Shack's *Dramatic Literature. Twice a week; both semesters.* Dr. SEYMOUR.

15. GENERAL SURVEY OF SPANISH LITERATURE.—An introduction to more extended study of special periods and authors. *Twice a week; second semester.* Dr. SEYMOUR.

B. History and the Social Sciences

Economics

Every student entering upon graduate work in economics must have had a course in the principles of the science and also in some special part of the field, such as public finance or money and banking. The work should represent about eight semester hours.

Graduate students who are making economics their major are required during their first year to acquaint themselves with the works of the masters in the science, either by taking course 101 or by private reading for examination. In the second or third year they will be expected to elect courses 105 and 120, and some fundamental course in political science and sociology (either course 11 or 102 in sociology, and political science 101 and 102) unless they have already had such courses. Candidates for the master's degree are examined on the whole year's work, late in May or early in June.

Complete sets of all the important French, German, Italian, English, and American economic and financial journals are in the library, as well as a number in other languages; more than ninety periodicals, foreign and domestic, in economics, finance, commerce, industry, statistics, etc., are currently received. The library is unusually strong in railroad literature, economic history, labor, finance and general theory.

Courses for Graduates

101. ECONOMIC THEORY.—This is a survey of the field of general economic theory, with emphasis on theories of distribution and their relation to the ethical, philosophical and political views of this and other periods. The course must be taken in the first year of graduate work by all students who have not had its equivalent. *Twice a week; both semesters. One unit.*

[Not given in 1913-1914.] Professor KINLEY.

102. Advanced General Economics.—A survey of the whole field as presented in the works of such writers as Marshall, Pierson, Philippovich. *Twice a week; both semesters. One unit.* Professor Kinley.

[Not given in 1913-1914.]

103. Railway Administration.—Topics relating to current railway management are assigned for investigation, report and discussion. The course is primarily intended for candidates for the degree of A. M. in Railway Administration. *Once a week; both semesters. Half unit.*

Professor Dewsnup.

104. Foreign and Colonial Trade of the United States.—A detailed study of the foreign commerce of the United States based upon the use of governmental publications. *Twice a week; second semester. One unit.*

Assistant Professor Litman.

105. Public Finance.—The history and theory of public revenue and expenditure, *Twice a week; both semesters. One unit.* Professor Bogart.

106. Railway Policy.—A. History of railway development in the United States. B. History of railway development in foreign countries, particularly in western Europe. C. The State and the Railway.

The cycle of topics requires three years for the completion of the course. The topic in 1913-1914 is A. *Once a week; both semesters. Half unit.* Professor Dewsnup.

107. The Corporation in Economic Evolution.—*Once a week; both semesters. One quarter unit.* Professor Robinson.

[Not given in 1913-1914.]

109. Theory of Industrial Consolidations.—The nature of industrial consolidations; the conditions and causes responsible for their development and their effects upon the production and distribution of wealth. *Once a week; both semesters. One-quarter unit.* Professor Robinson.

118. Seminar.—The Seminar meets weekly for the discussion of the results of students' investigation, etc.

Members of the Staff.

120. History of Economic Thought.—*Twice a week; first semester. One unit.* Dr. Thompson.

122. Advanced Economic History of the United States.—*Twice a week; both semesters. One unit.*
[Not given in 1913-1914.] Professor Bogart.

Theory of Statistics.—See Mathematics 129.

Courses for Graduates and Advanced Undergraduates

4a. Financial History of the United States to the Civil War.—A study of colonial and federal finance, including currency, banking, tariff and fiscal questions. *Twice a week; second semester.* Assistant Professor Weston.
[Not given in 1913-1914.]

4b. Financial History of the United States since 1860.—A study of the finances of the Civil War and reconstruction period, and of the recent development of both public and private finance, with special reference to business conditions. *Twice a week; second semester.*
Assistant Professor Weston.

5. Public Finance.—Public debts, revenue, taxation, etc. *Three times a week; first semeter.*
Professor Bogart.

8. The Money Market.—An advanced study of dealings, in money, credit, foreign exchange, crises, etc. *Twice a week; second semester.* Assistant Professor Weston.

10. Corporation Management and Finance.—*Three times a week; first semester.* Professor Robinson.

11. Industrial Consolidation.—The development of industrial consolidations; plans for controlling trusts, etc. *Three times a week; second semester.*
Professor Robinson.

12. Labor Problems.—*Three times a week; first semester.*
Professor Kinley.

13. Economic Development of Europe Since the Industrial Revolution.—*Three times a week; second semester.*
Professor Bogart.

17. Economic History of Agriculture.—General characteristics of agriculture, and its development as an industry in various countries at various times. State of the agricultural class. Relation of agriculture to other industries. Relation of the state to agriculture. *Twice a week; second semester.* Dr. Thompson.

21. Socalism and Economic Reform.—*Three times a week; second semester.* Professor Kinley.

29. Foreign Commerce and Commercial Politics.—A study of the various commercial systems, mercantile, free trade and protective, etc. *Three times a week; first semester.* Assistant Professor Litman.

30. Tariff and Customs Regulations of the United States.—*Three times a week; second semester.* Assistant Professor Litman.

41. Railway Transportation.—A study of the more general aspects of railway transportation in the United States, with reference to conditions abroad. *Three times a week; first semester.* Professor Dewsnup.

42. Railway Rates, their Construction and Regulation.—A somewhat detailed study of the rate structure of the United States, followed by a discussion of rate theory and the policy of the Interstate Commerce Commission. *Three times a week; second semester.* Professor Dewsnup.

43. The Theory and Practice of Railway Administration.—A description of the organization and methods of traffic management and a discussion of the problems connected therewith. *Twice a week; both semesters.* Professor Dewsnup.

45. Railway Operation.—A study of the organization, methods of management, and associated problems of the operating department of the railroad. *Twice a week; both semesters.* Professor Dewsnup.

HISTORY

A student entering upon graduate work should have had at least the equivalent of the introductory college courses in European and American history, roughly equivalent to History 1 and 3. All historical students should have a reading knowledge of German and French; for medieval history some knowledge of Latin is indispensable, and in certain fields of American history Spanish is needed.

Advanced courses in history at the University of Illinois are of three kinds: (1) Instruction in methodology, historiography, and bibliography. This work (in course 103) is re-

quired of all graduate students in history during their first year. (2) Seminary courses for the study of special fields with a view primarily to training in the methods of historical criticism and research. (3) Courses for information and guidance in general reading. Opportunities for research are offered in the following fields: Medieval history; English history with emphasis upon medieval institutions; modern European history: American history with special reference to institutions, colonial society, western development, and the period of sectional conflict, 1840-65; the history of Latin America.

Illinois Survey.—Historical students have an opportunity to pursue research in western history in connection with the Illinois Survey, which is an organization for the purpose of carrying on systematic studies in the history of Illinois.

Attention is also called to the fact that the University of Illinois has for some time co-operated with the Illinois State Historical Society and the trustees of the State Historical library, in the gathering and editing of archive material. As a result of this relation instructors and graduate students in the department have contributed from time to time to the publications of these state organizations and have been given useful training in the study of manuscript as well as printed material.

The Historical Club, consisting of instructors and graduate students in the department, meets once a month. The program is devoted to reviews of current progress in historical work and to reports of investigations.

HIGHER DEGREES IN HISTORY

The following statement regarding the specific requirements for higher degrees in History is subject to the general requirements of the Graduate School as set forth on pp. 9, 12, 15 above.

MASTER OF ARTS

In addition to meeting the general tests in the specific courses taken, each candidate is expected to pass a general oral examination, and written examinations in any two fields

selected from the following: Ancient History; Medieval History of Continental Europe; Modern History of Continental Europe; English History; American History. Candidates for this degree are expected to have a general knowledge of historical bibliography and methodology (see course 103).

DOCTOR OF PHILOSOPHY

Major Requirements.—In view of the broad scope of historical studies and in order to secure greater thoroughness, a candidate who selects history as his major subject may for the present offer himself for examination in any four of the fields indicated below, stating also the particular field among these four in which he wishes to specialize and in which his thesis is to be written:

1. Ancient History (with special reference to Greece and Rome). 2. Mediaeval History and institutions of Continental Europe (to the close of the thirteenth century). 3. Continental Europe from 1300 to 1648. 4. Continental Europe and its Dependencies since 1648 (except as included in 5 and 6). 5. The History of England and its Dependencies (not including America before 1783). 6. American History (except as included in 5, and with primary reference to the United States). This enumeration of fields is not to be regarded as excluding the possibility of accepting others as may be determined by the Department in individual cases.

Minor Subjects.—A candidate for the doctorate in history may select as his first minor one of the divisions of the field of history listed above which is not offered as a part of his major. He should preferably, however, select his minors from subjects offered by other departments. The following list of suitable minors is intended to be suggestive rather than exhaustive or compulsory.

I. In Political Science.—(Any two acceptable for a first minor; any one, for a second minor): 1. International Law and Diplomacy. 2. Modern Government. 3. Municipal Government. 4. Constitutional and Administrative Law and Jurisprudence. 5. Political Theory.

II. In Economics and Sociology.—(Any two acceptable for a first minor; any one, for a second minor): 1. Economic history. 2. Economic theory. 3. Public and Private Finance. 4. Social reform. 5. Principles of Sociology.

III. In Philosophy and Education.—(Any two acceptable for a first minor; any one, for a second minor): 1. History of Ancient and Mediaeval Philosophy. 2. History of Modern Philosophy. 3. History of Education.

IV. In Literature.—Some division of the history of literature which may be either the comparative literature of a limited period or the literature of a particular country for a more extended period as may be agreed upon in each case.

Courses for Graduates

101. Seminary in American History.—Bibliography; practise in the solution of typical problems; reports on the progress of individual investigations by instructors and students. *Two hours, once a week; both semesters.*

Professor Greene and others.

Students interested in the investigation of particular topics, whether with a view to writing theses or otherwise, may register in this course and will be advised by members of the department as follows:

On American history before 1789 and problems of church and state, Professor Greene.

On American history after 1789 and Latin-American history, Assistant Professor Robertson, Dr. Cole.

On the history of the West,

Professor Alvord, Dr. Buck.

102. Studies in English History.—*Twice a week; both semesters.** Professor Larson.

103. Historical Bibliography and Criticism.—Selected problems in various fields. Required of all candidates for an advanced degree in history who do not present evidence of similar training elsewhere. *Twice a week; both semesters.*

Associate Professor Lybyer and others.

104. Research in European History.—Competent students will be guided in the investigation of topics in medieval and modern history. In connection with History 102 and 104, there will be a fortnightly conference of instructors and graduate students in European history. *Both semesters.*

Associate Professor Lybyer and Assistant Professor Duncalf.

105. The History of Western Expansion, 1763-1818.—

* The unit value for graduate students of courses in this department is subject to arrangement on registration.

The period indicated is covered by lectures and readings, but the main object of the course is the study of various problems in the interpretation of western history. *Once a week; both se nesters.* Professor ALVORD.

111. SPANISH-AMERICAN RELATIONS.—The relations of the Latin-American States with Europe and the United States. An intensive study of such topics as the Monroe Doctrine, the development of international trade, etc. A reading knowledge of either French or Spanish is expected. *Once a week; both semesters.* Assistant Professor ROBERTSON.

112. THE HISTORY OF CHURCH AND STATE RELATIONS IN AMERICA.—*Two hours a week; second semester.* [Not given in 1913-14.] Professor GREENE.

Courses for Graduates and Advanced Undergraduates

4. CONSTITUTIONAL HISTORY OF ENGLAND.—During the first semester the emphasis is placed on institutional origins; in the second semester particular attention is given to modern constitutional practise. *Three times a week; both semesters.* Professor LARSON

8. MEDIEVAL CIVILIZATION IN ENGLAND.—This course traces the religious, economic, and intellectual development of English society in the Middle Ages. Emphasis is placed on social changes and the growth of culture. Attention is called in this connection to History 19. *Twice a week; first semester.* Professor LARSON.

9. EUROPEAN SOCIETY IN THE LATER MIDDLE AGES AND THE PERIOD OF THE RENAISSANCE.—The transition from Medieval to Modern ideals. This course is an appropriate continuation of Course 19, though either may be taken separately. *Twice a week; second semester.* Assistant Professor DUNCALF.

10. THE DEVELOPMENT OF AMERICAN SOCIETY IN THE EIGHTEENTH CENTURY.—An introduction to the study of the American Revolution. *Three times a week; second semester.* Professor GREENE.

12. HISTORY OF GERMANY.—*Twice a week; both semesters.* [Not given in 1913-14.]

14. THE MAKING OF THE FEDERAL CONSTITUTION.—The political, economic and social conditions from 1783-1789 which resulted in the framing and ratification of the federal consti-

tution of 1787; the contemporary arguments for and against the ratification of the Constitution. *Twice a week; first semester.*
Professor GREENE.

15. THE CIVIL WAR AND THE RECONSTRUCTION.—*Three times a week; second semester.* Dr. COLE

16. THE HISTORY OF THE EXPLORATION AND COLONIZATION OF THE WEST.—First semester: The Mississippi Valley from the beginning of the Spanish explorations to the close of the War of 1812; second semester: the development of the Mississippi Valley since 1815 and the progress of Westward expansion to the Pacific. By permission of the instructor the second semester may be taken separately. *Twice a week; both semesters.* Professor ALVORD.

19. MEDIEVAL SOCIETY WITH SPECIAL REFERENCE TO CONTINENTAL EUROPE IN THE ELEVENTH AND TWELFTH CENTURIES.—A study of institutions and economic conditions with a view to illustrating the Crusades and other characteristic movements of the period. May be combined to advantage with History 8 (Medieval Civilization in England). *Twice a week; first semester.* Assistant Professor DUNCALF.

20. EUROPE FROM THE PERIOD OF THE NAPOLEONIC EMPIRE TO THE PRESENT TIME.—The Nineteenth Century to the formation of the German Empire in 1871; second semester: Europe since 1871. Either semester may be taken separately. *Three times a week; both semesters.* Associate Professor LYBYER.

21. THE HISTORY OF THE UNITED STATES SINCE THE CIVIL WAR.—Historical introduction to contemporary American Politics. *Twice a week; first semester.*
Assistant Professor ROBERTSON.

26. THE HISTORY OF THE LATIN-AMERICAN COLONIES.—The political, economic, social, and intellectual life of Spain during the period of discovery. The exploration, settlement and civilization of Spanish America and the Philippines. Some attention is also given to the exploration and colonization of Brazil. *Three times a week; first semester.*
Assistant Professor ROBERTSON.

27. HISTORY OF LATIN-AMERICA FROM THE WAR OF INDEPENDENCE TO THE PRESENT TIME.—The national history of the leading Latin-American states with special attention to political parties, existing governments and the relations with

Europe and the United States. A study of the old regime in Texas, Mexico and California. *Three times a week; second semester.* Assistant Professor ROBERTSON.

POLITICAL SCIENCE

Graduate work in Political Science is conducted in the following special fields: (1) Political Theory; (2) International Law and Diplomacy; (3) Comparative Government; (4) Constitutional Law, Administrative Law and Jurisprudence; (5) Municipal Administration.

No student is considered qualified to carry graduate work in political science who has not had at least the equivalent of the introductory college course in government and history. A reading knowledge of German and French is highly desirable and in some of the courses is indispensable.

Candidates for the master's degree are expected not only to meet the requirements of the particular courses for which they are registered but also to do such general reading as in the judgment of the department may be necessary to give the student a general view of the field as a whole. Candidates for the doctorate who make political science their major subject will be required to show a more thorough knowledge of the whole field in addition to a special familiarity with the particular subjects in the group or groups in which they are working. They are also required to select two minor subjects and must enroll in the seminar course (no. 103) which is devoted to thesis work.

A student majoring in political science may by special permission take one of his minors in the same department, and may select one of the above groups as his major and one as a minor.

If a student majoring in political science is taking both of his minors in other departments, one of them must be either in history, economics or sociology.

Several courses given in other departments are so closely related to those in political science that graduate students majoring in political science may be permitted with the consent of the department to take such courses and count them as a part of their work. Among these courses are: Economics 5 (Public Finance); History 4 (English Constitutional History); History 14 (Making of the Federal Constitutional);

History 27 (History of the Latin-America); History 111 (Spanish-American Diplomacy); Sociology 6 (Problems of Urban Communities); Sociology 9 (Criminology); Law 24 (Municipal Corporations). In this connection attention may also be called to the technical courses given by the department of Municipal and Sanitary Engineering.

Courses for Graduates

101. History of Political Theories.—Development and history of Ancient, Medieval, and Modern Political thought Poitical theories of Aristotle, Machiavelli, Hobbes, Locke, Rousseau, Montesquieu, and others; evolution of American Political ideas. *Twice a week; first semester. One unit.*
Professor Garner.

102. The Nature of the State.—The principles, methods and relations of political service; the origin, nature, forms and functions of the State; sovereignty and liberty; citizenship and nationality; constitutions; principles of political organization. *Twice a week; first semester.* (This course is given in alternate years with Course 101; it will not be given in 1913-14) *One unit.* Professor Garner.

103. Seminar in Political Science and Public Law.—*Once a week; both semesters. Credit value depends upon amount of work done.* Members of the Department.

104. Municipal Administration.—Studies in municipal organization and functions in the United States and Europe; the relations between city and state, local organization, political methods and reform movements, police and health administration, public works, municipal ownership and public utilities, municipal finances. The particular topics considered differ from year to year. *Three times a week; second semester. One and one-half units.* [Not given in 1913-14.]
Professor Fairlie.

105. Special Topics in Constitutional Law of the United States.—For 1913-14 the subject for discussion is that of judicial power over legislation. *Twice a week; second semester. One unit.* Assistant Professor Dodd.

Courses for Graduates and Advanced Undergraduates

4. Municipal Government.—The growth of cities; municipal home rule; municipal organization and functions in the

United States; the mayor and council; commission government; police, light and water supply; city planning; urban transportation; municipal ownership and regulation of public utilities. *Three times a week; first semester.*

Professor FAIRLIE.

5. CONSTITUTIONAL LAW OF THE UNITED STATES.—*Four times a week; first semester.* Assistant Professor DODD.

6. INTERNATIONAL LAW.—*Three times a week; first semester.* Professor GARNER.

7. AMERICAN DIPLOMACY.—A study of genesis and present organization of the Department of State; the diplomatic service; the treaty making power; the methods and traditional principles of the foreign policy of the United States; historical review of the principal diplomatic controversies between the United States and foreign powers from the foundation of the government to the present time; the rise of the United States to the position of a world power. *Twice a week; second semester.* Dr. MATHEWS.

9. PRINCIPLES OF JURISPRUDENCE. The nature of law; historical development of the English legal system; English common law in the United States; sources of law and relation between statutes and judicial decisions; brief discussions of the various branches of law (crime, tort, contract, etc.) and their relation to one another. *Three times a week; first semester.* Assistant Professor DODD.

10. ADMINISTRATIVE LAW IN THE UNITED STATES.—Separation of governmental powers and the delegation of legislative power; federal and state administrative organs; methods of enforcing governmental commands; remedies of the individual against unlawful action by public officers. *Three times a week; second semester.* Assistant Professor DODD.

11. CONSTITUTIONAL ASPECTS OF SOCIAL AND INDUSTRIAL PROBLEMS.—The police; constitutional limitations upon legislation concerning the public health and safety; the control of public service corporations and combinations of capital and labor. *Three times a week; second semester.*

Assistant Professor DODD.

12. NATIONAL ADMINISTRATION IN THE UNITED STATES.—A study of the President and his Cabinet; the executive departments and the administrative services of the national govern-

ment, etc. *Three times a week; second semester.* [Not given in 1913-1914.] Professor FAIRLIE.

13. STATE ADMINISTRATION IN THE UNITED STATES.—The adminstrative position of the governor, and the organization of the state administrative departments. Organization and powers of state boards, commissions and quasi-judicial tribunals. Tendencies towards centralization in state functions. Methods of control over state administrative officers. *Three times a week; first semester.* Dr. MATHEWS.

14. POLITICAL PARTIES.—A study of the development of political parties and their organization and influence on the government mainly of Great Britain and the United States, with attention to recent legislation in primaries and nomination methods in this country. *Twice a week; first semester.* Professor FAIRLIE.

18. WORLD POLITICS.—The main currents of international politics in Europe since the Treaty of Berlin. The colonial expansion of the United States since the Spanish War, and the present position of the United States as a world power. *Three times a week; second semester.* [This course is given in alternate years; course 7 will be given in its place in 1913-1914.] Dr. MATHEWS.

21. BRITISH GOVERNMENT.—Political Institutions in the United Kingdom and the British Possessions. *Three times a week; first semester.* Professor FAIRLIE.

22. CONTINENTAL EUROPEAN GOVERNMENT.—A comparative study of the national political systems of France, Germany, Italy, Austria-Hungary and Switzerland. *Three times a week; second semester.* Professor GARNER

28. PROBLEMS OF CONTEMPORARY POLITICS.—The initiative and the referendum; proportional representation; state socialism; universal sufferage; electoral reform; local self-government; judicial reform; parliamentary government; the Monroe Doctrine, etc. *Twice a week; second semester.* Professor GARNER.

SOCIOLOGY

Preparation for graduate work in sociology must include at least the equivalent of twelve semester hours in the social sciences, of which at least three must be in sociology, and three in the principles of economics. The remainder may be

in any combination of these two subjects, or of history and political science.

The graduate courses in this department are of two classes: Those of the first class deal with the principles of general sociology; these principles relate to the essential nature of customs, institutions, and other forms of social activity, the correlations between them, the types of causes by which they are affected, and the method by which they are evolved, all of which apply equally to the forms of social activity whether they are employed in the service of economic, political, or other purposes. The courses of the second class treat, in the light of the principles of general sociology, the practical social problems of the present.

The library has most of the standard works in general sociology by American, English, and European authorities, a large collection of books on various sociological problems, and an extensive list of periodicals. Special attention is given to ethnographic and anthropologic materials.

Courses for Graduates

101. Sociological Method.—The method of advancing the science of sociology; adaptability to sociological investigation of certain methods described in Pearson's Grammar of Science, Wundt's Methodenlehre, zweite abtheilung, Seignobos' La Méthode Historique Appliquée aux Sciences Sociales, Bernheim's Historische Methode, Spencer's Study of Sociology, and Giddings' Inductive Sociology. *Three times a week; first semester. One unit.* Professor Hayes.

102. The Development of Sociology.—A reading course in the works of writers who have contributed most to the development of sociology, with discussions and supplementary lectures. *One session, two hours, each week; both semesters. One unit.* Professor Hayes.

150. Seminar.—*One session of two hours each week; both semesters. One to two units.* Professor Hayes.

(Note: One of the three courses above described will be omitted in 1913-1914; which one is omitted will depend upon the election of students.)

Courses for Graduates and Advanced Undergraduates.

11. PRINCIPLES OF SOCIOLOGY.—Fundamental principles and main teachings of sociology, derived from a minute analysis and classification of the elements that make up the life of a people, types of change to which they are subject, and causes by which they are affected. *Three times a week; first semester.* Professor HAYES.

3. SOCIAL EVOLUTION.—A course for students who desire acquaintance with the comparative method of dealing with questions of theory in the social sciences, presenting a large body of facts concerning the various forms of social activity, mainly in their more primitive stages as shown by savage and barbarous peoples, with inductions from such facts concerning the theory of social evolution and the method of progress. *Three times a week; second semester.* Professor HAYES.

8. CHARITIES.—Brief study of the evolution of modern organized philanthropy, public and private; causes and prevention of poverty; organization and management of charitable institutions. *Three times a week; first semester.* Dr. TODD.

9. CRIMINOLOGY.—Nature, causes, and treatment of the criminal; evolution of modern method of criminal procedure and penology; recent experiments and tendencies. *Three times a week; second semester.* Dr. TODD.

10. POPULATION.—Theories and policies of population; Malthus' "Principle" and its critics; problems in population of United States; immigration, race mixture, conditions affecting public health, death-rate, birth-rate, "race-suicide," marriage, divorce, etc.; selective influences at work on the "Population type." *Three times a week; first semester.* Dr. TODD.

15. THE FAMILY.—Evolution of the family and marriage; educational, moral, and political significance of the family at different stages of social development. *Twice a week; both semesters.* Dr. TODD.

26. SOCIAL EDUCATION.—Education as a factor in social progress. Present day education policy and organization in the light of theoretical and applied sociology. *Three times a week; second semester.* Dr. TODD.

12. The Labor Problem.—See Economics 12.
21. Socialism and Social Reform.—See Economics 21.

C. Education, Philosophy and Psychology

EDUCATION

Students who elect education as a major subject must have completed at least a three-hour course in the Principles of Education, a similar course in the History of Education, and at least three hours in Psychology and three in Philosophy. For graduate students who have had experience in teaching, these requirements may be modified.

Courses for Graduates

119. The Elementary Curriculum.—An intensive study of materials and methods of instruction in the elementary school. *Three times a week; second semester. One unit.*
Professor Coffman.

106. Seminary in Secondary Education.—*First and second semesters.* Arrange hours and unit values.
Professor Johnston.

125. Seminary in Educational Psychology.—*Twice a week; second semester. One unit.*
Professor Bagley.

105. Seminary in the History of Education.—*First and second semesters.* Arrange hours and unit values.
Assistant Professor Anderson.

108. History of Industrial and Vocational Education. *Twice a week; second semester. One unit.*
Assistant Professor Anderson.

112. Principles of Education.—A course for graduate students who are not majoring in education. *Twice a week; first semester. Half unit.*
Professor Bagley.

111. Practice Teaching. [Not given in 1913-14.]

114. Higher Education.—Problems of organization, administration and teaching in colleges and universities. *First semester.* Arrange hours and unite values.
Professor Johnston.

Departmental Conference.—*Once a fortnight; first and second semester.*

Technical Courses for Graduates and Advanced Undergraduates.

6. PRINCIPLES OF SECONDARY EDUCATION.—The function of the secondary school in a system of education. *Three times a week; first semester.* Professor JOHNSTON.

27. THE SECONDARY CURRICULUM.—An analysis of the secondary studies with particular reference to their functions and values. *Three times a week; second semester.* Professor JOHNSTON.

18. METHOD IN EDUCATIONAL RESEARCH.—The principles and technique of the statistical method as applied to educational investigation. *Twice a week; second semester.* Professor COFFMAN.

4. GENERAL EDUCATIONAL ADMINISTRATION.—A survey of educational systems, with especial reference to adminstrative problems in the elementary school. *Three times a week; first semester.* Professor COFFMAN.

7. HIGH SCHOOL ADMINISTRATION.—The specific problems of the administration of secondary schools. *Three times a week; second semester.* Professor JOHNSTON.

20*a*. THEORY OF SUPERVISION.—Principles and methods involved in the training of teachers in service. *Three times a week; second semester.* Professor COFFMAN.

20*b*. THEORY AND PRACTICE OF SUPERVISION.—Education 20*a* with two additional hours devoted to the inspection and criticism of teaching. *Five times a week; second semester.* Professor COFFMAN.

41. VOCATIONAL EDUCATION.—An examination of the institutions and methods of vocational and industrial education. *Twice a week; first semester.* Professor BAGLEY.

42. AUXILIARY EDUCATION.—An examination of the institutions and methods involved in the training of defectives and delinquents. (Not offered in 1913-14.)

General Courses for Advanced Undergraduates and Graduates

5*a*. COMPARATIVE EDUCATION (GENERAL).—A comparative study of the educational systems of the United States, Canada, Great Britain, Germany, France, Austria, Italy, and Japan, with especial reference to elementary education. *Three times a week; first semester.* Assistant Professor ANDERSON.

5*b*. Comparative Education (Secondary Systems).—A comparative study of secondary schools in the principal civilized countries. *Three times a week; second semester.*

Professor Johnston.

13*a*. Educational Classics.—A study of the writings of the educational reformers from Plato to Locke. *Three times a week; first semester.* Assistant Professor Anderson.

13*b*. Educational Classics.—A study of the writings of educational reformers from Locke to the present time. *Three times a week; second semester.*

Assistant Professor Anderson.

12. History of American Education.—The origin and development of the state systems of common schools. *Twice a week; first semester. One half unit.*

Assistant Professor Anderson.

PHILOSOPHY

Every student entering upon graduate work in philosophy must have had a thorough general course in the history of philosophy and a course in logic. A general course in psychology is also required.

Courses for Graduates

101. The Philosophy of Plato and Aristotle.—*Twice a week; first semester. One unit.* Professor Daniels.

102. Seminar—Contempary Philosophy. The Philosophy of Bergson. *Twice a week; both semesters. One unit.*

Professor Bode.

103. Seminar.—Ethical Theory. *Twice a week; first and second semesters. One unit.* Professor Daniels.

104. The Philosophy of Descartes, Spinoza and Leibniz.—*Twice a week; first semester. One unit.* Professsor Daniels.

[Not given in 1913-1914.]

105. The Philosophy of Kant and Schopenhauer.—*Twice a week; second semester. One unit.* Professor Daniels.

[Not given in 1913-1914.]

Courses for Graduates and Advanced Undergraduates

3. History of Ancient and Medieval Philosophy.—*Three times a week; first semester.* Professor Daniels.

4. History of Modern Philosophy.—*Three times a week; second semester.* Professor Daniels.

7. Ethics.—The beginnings and growth of morality; analysis, and criticism of the leading conceptions of moral theory; discussion of some of the typical social and economic problems of the present. *Three times a week; second semester.* Professor Daniels.

11. Philosophy of Religion.—The philosophical interpretation of religious consciousness and a critical study of various religious concepts: God, revelation, inspiration, dogma, faith, prayer, immortality, the problem of evil, the relation of morality and religion. *Twice a week; second semester.* Professor Daniels.

15. The British Philosophers of the Eighteenth Century.—Locke, Berkeley and Hume. *Three times a week; first semester.* Professor Bode.

16. American Philosophy.—*Twice a week; second semester.* Professor Bode.

17. Advanced Logic.—*Three times a week; first semester.* Dr. Shepherd.

18. Logical Theory in its Bearing on Philosophic Problems. *Three times a week; second semester.* Dr. Shepherd.

19. The Development of Religious Thought in the Eighteenth and Nineteenth Centuries.—*Three times a week; first semester.* Dr. Shepherd.

PSYCHOLOGY

No student may do graduate work in psychology without having had at least six hours in elementary psychology, and at least one three-hour course in philosophy.

Courses for Graduates

101. Research.—Advanced problems; theses offered for graduate degrees. *Both semesters.* Professor Bentley, Dr. Sutherland.

102. Contemporary Literature.—Seminar meetings for the discussion of current topics considered in their historical setting. *Both semesters.* Professor Bentley, Dr. Sutherland.

113. Psychology of the Abnormal.—Defects of sensation; illusions and hallucinations; automatisms, trance states and

hypnosis; suggestion and dreams; the subconscious; defects of speech; defects of emotion and volition; defects of memory and association; obsessions and impulsions; genius and insanity; temperament and personality. *Second semester.*

Dr. SUTHERLAND.

Courses for Graduates and Advanced Undergraduates

6. COMPARATIVE PSYCHOLOGY.—Mind in the various animal forms; the psychological implications of the bionomic doctrine of descent; a comparison of human and animal minds; criticism of current literature. (Recommended to students who intend to do advanced work either in animal psychology or in the study of behavior). *Twice a week; first semester.*

Professor BENTLEY.

9. PHYSIOLOGICAL PSYCHOLOGY.—The physiology and psychology of the central nervous system. Lectures; laboratory. *Twice a week; first semester.* Dr. SUTHERLAND.

12. MINOR PROBLEMS.—The formulation of methods suitable to new problems, and the conduct of small investigations. (At the discretion of the department, studies in the current literature or the presentation of essays upon historical subjects may be substituted for laboratory problems.) *Two to five times a week; both semesters.*

Professor BENTLEY, Dr. SUTHERLAND.

D. The Sciences, Including Mathematics.

ASTRONOMY

The prerequisites for graduate study in astronomy are mathematics through the calculus, a year's course in observational astronomy, and a course in college physics.

Course for Graduates

101. SEMINAR.—The work offered to graduate students is largely governed by the preparation and abilities of different individuals. *Three times a week; both semesters.*

Assistant Professor STEBBINS.

Courses for Graduates and Advanced Undergraduates

7. THEORETICAL ASTRONOMY.—This course begins with the elementary theory of the motions of the heavenly bodies, and

is intended to lead the student up to the actual computation of a cometary orbit. *Three times a week; both semesters.* Dr. Reed.

9. Celestial Mechanics.—A continuation of course 7. Introduction to the theory of disturbed planetary motion. *Three times a week; both semesters.* Dr. Reed.

14. Observational Astronomy.— This course is intended for those who wish to become familiar with the working methods of an astronomical observatory. The problems set for solution are largely individual. *Three times a week; second semester.* Dr. Reed.

15. Geodetic Astronomy.—Advanced work with the sextant, transit, and zenith telescope. *Three times a week; first semester.* Dr. Reed.

BOTANY.

The work outlined under "Courses for Graduates" is open only to those who have had liberal botanical training including at least one year of successful study in the particular line in which it is desired further to specialize. These Courses may be elected for minor or for major work.

Courses for Graduates

101. Cytology.—The influence of external agents on the cell. Special subjects for investigation are assigned upon consultation. Reports and discussions of current literature and research results. *Twice a week; both semesters. One or two units.* Assistant Professor Hottes.

102. Physiology.— The effects of external stimuli on growth and movement. Special subjects for investigation are assigned upon consultation. Reports and discussions of current literature and research results. *Twice a week; both semesters. One or two units.* Assistant Professor Hottes.

103. Bacteriology.—Theories of fermentation, growth and death of bacteria. *Twice a week; first semester. One unit.* Assistant Professor Rahn.

104. Mycology.—Field and laboratory investigations upon selected groups of fungi. Individual assignments of subjects and problems. *Twice a week; both semesters. One unit.* Assistant Professor————.

105. Bacteriology.—Variability of species characters,

Mutations, Standard and biometrical classification. *Twice a week; second semester. One unit.* Assistant Professor RAHN.

106. VEGETABLE PATHOLOGY.—Diseases of plants and disease agents. Special subjects are assigned upon consultation. *Twice a week; both semesters. One unit.*

Assistant Professor————.

107. BACTERIOLOGY RESEARCH.— Research in physiology of bacteria, and food bacteriology. Reports and discussions of current literature and research results. *Twice a week; both semesters. One or two units.* Assistant Professor RAHN.

Courses for Graduates and Advanced Undergraduates

After at least one year of approved botanical work and further prerequisites, on consultation, graduates may elect any of the courses 3, 7, 8, 9, 16, 17, with assigned additions, for minor credit.

3. CYTOLOGY AND PHYSIOLOGY.—The first semester is devoted mainly to cytology and histology, with special attention to technique; the second, to a study of influences of external stimuli on growth and movement. *Twice a week; both semesters.* Assistant Professor HOTTES.

7. PLANT PATHOLOGY.—First semester: the more important diseases of cultivated plants, the causes, and their effects upon the hosts; second semester: methods of investigation and control. *Twice a week; both semesters.*

Assistant Professor.....

8. APPLIED BACTERIOLOGY.— Decay of organic matter in nature; water bacteriology; sewage bacteriology; food bacteriology; pathological bacteriology. *Twice a week; both semesters.* Assistant Professor RAHN.

9. CYTOLOGY AND PHYSIOLOGY (ADVANCED COURSE).—Special laboratory problems in certain phases of cytology and physiology. *Twice a week; both semesters.*

Assistant Professor HOTTES.

16. STUDIES UPON SPECIAL GROUPS OF PLANTS.—Mostly field laboratory and herbarium work, and assigned reading. *Twice a week; both semesters.*

Assistant Professor.....

17. TAXONOMIC AND DESCRIPTIVE PRACTICE.—Monographic treatment of selected natural or ecological groups of higher

plants. Laboratory and field work with assigned reading and seminar conferences. *Twice a week; both semesters.*

Professor TRELEASE.

CERAMICS

Courses for Graduates

Persons desiring work in advanced silicate technology must be graduates of courses in ceramics, chemical engineering or general science. Students who are graduates in general Science are required to show sufficient training in inorganic and physical chemistry, mathematics, physics, mineralogy and geology to warrant the expectation that they will be able to do the work elected by them.

104. THE TECHNOLOGY OF GLASS.—Problems relating to the technology of glass. Topics: Fusion curves of glass silicates, limiting compositions, solubility of the oxides in glasses, devitrification, annealing, optical properties, solubility of glass, vicosity, thermal expansion, pyro-chemical volume change, etc. *Twice a week; both semesters. One unit.*

Mr. STULL.

Courses for Graduates and Undergraduates

Graduates of courses other than ceramics or ceramic engineering may take the following courses for minor credit.

3. INDUSTRIAL CALCULATIONS.—The designing and operation of furnaces, kilns and dryers; temperature measurement. *Three times a week; first semester.* Mr. HURSH.

5. BODY MAKING.—Composition of ceramic wares; physical and chemical changes produced by the blending of the various ceramic materials; machinery and processes employed in shaping the various products. *Five times a week; second semester.* Mr. STULL, Mr. RADCLIFFE.

6. GLAZES.—The production of glazes and enamels; classification; properties and defects common to each class; the effect of variation in composition; modes of application. *Five times a week; first semester.* Mr. STULL.

8. PRINCIPLES OF GLASS MANUFACTURE.—The raw materials, preparation, compounding, melting and shaping of glass; chemical principles involved in the manufacture and decoration of the different types of vitreous silicates. *Three times a week; second semester.* Mr. STULL.

10. CEMENTS.—Limes, plasters, cements, sand-lime stone, and other cementing materials; composition, reactions, methods of manufacture and testing. *Three times a week; first semester.* Mr. HURSH.

14. CEMENT LABORATORY.—The production of water-proof and sea resisting cements; cement colloids; polychrome pigments for fresco decoration; cement colors; cold water paints. *Three times a week; second semester.* Mr. HURSH.

CHEMISTRY

Graduate students whose major subject is in some other department than chemistry, before taking graduate work for credit in this department, must have had the equivalent of 15 University hours in chemistry, and the ground covered must have included satisfactory work in general chemistry and in qualitative and quantitative analysis. Such students are advised to take Chemistry 31, 33, 102, 102a, 5b, 5c, 15, 14, and 9a and 9b. Courses of a more special nature will not, as a rule, be accepted for graduate work unless preceded by one of the above courses.

For students in agriculture, 5a and 13b will not be accepted for graduate credit.

Graduate students who are candidates for an advanced degree in chemistry must have had the equivalent of 30 University hours in chemistry, and this must include satisfactory courses in general chemistry, qualitative and quantitative analysis, physical chemistry, and organic chemistry. The physical chemistry requires also one year'swork in physics as a prerequisite. Before receiving the degree of Doctor of Philosophy such students are expected to complete work equivalent to courses 31, 33 (or 102 and 102a), 14, 9a, 9b, 101 and 111. They are advised to take at least brief courses in gas analysis, iron and steel analysis, water analysis, assaying and chemical technology.

For students in chemistry, 5a, 13a, 9 and 9c will not be accepted for graduate credit and 9a, 9b, 14, 31 and 33 will be accepted only from the students entering the Graduate School with the equivalent of 30 University hours in chemistry.

Courses for Graduates

101. History of Chemistry.—Lectures. Pattison Muir's *History of Chemical Theories and Laws*, and assigned reading. *Twice a week; first semester. Half unit.* Dr. Smith.

102. Advanced Physical Chemistry.—This course consists of lectures and seminar meetings and, together with 102a, is intended to cover a period of two years. The subject is treated from the standpoint of *Avogadro's Principle and Thermodynamics.*

The primary purpose of this course is to develop power to handle successfully a physico-chemical problem rather than merely to impart a knowledge of the phenomena and the principles involved. *Nernst's Theoretische Chemie, 7th edition. Twice a week; both semesters. Three-quarters unit.* [Not given in 1913-1914.] Assistant Professor Washburn.

102a. Advanced Physical Chemistry.— A continuation of course 102. This course alternates with course 102. *Nernst's Theoretische Chemie. Twice a week; both semesters. Three-quarters unit.* Assistant Professor Washburn.

102b. Advanced Electrochemistry.—This course deals with the modern theories of solution and the principles of thermodynamics in their application to the problems of electro chemistry. The subjects of electrolytic conductivity and transference, electromotive force, and the energy principles underlying the transformations of chemical and electrical energy are discussed in detail. LeBlanc's *Electrochemistry. Three times a week; second semester. One unit,*

Dr. MacInnes.

102c. Advanced Physical and Electrochemistry.—A laboratory course dealing with the application of physico-chemical methods to special problems. The nature of the experiments performed by the student will depend upon his previous training in this subject and his purpose in taking the course. The experiments are designed to develop the power of independent thinking in applying physico-chemical methods to problems in the laboratory. This course must be preceded or accompanied by courses 102, 102a, or 102b. *Twice a week; first semester. Three-quarters unit.*

Assistant Professor Washburn, Dr. MacInnes.

102d. Electrochemistry.—This course, which is in-

tended primarily for students of electrical engineering, includes a discussion of theoretical and applied electrochemistry with the emphasis chiefly on the technical side of the subject. *Once a week; both semesters. Half unit.*

Dr. MacInnes.

102e. Special Topics in Physical Chemistry.—A detailed study of certain branches of physical chemistry and its applications will be taken up in this course. The course will be conducted on the seminar plan and the topics considered will vary from year to year. Subject for 1913-1914; Free Energy and the Nernst Heat Theorem. *Once a week; first semester. Half unit.* Assistant Professor Washburn.

103. Advanced Inorganic Chemistry.—A systematic presentation of descriptive inorganic chemistry, including the rarer elements and based on the periodic system. The work consists of two lectures a week throughout the year, which may or may not be accompanied by laboratory work on advanced inorganic preparations. *Two to five times a week; both semesters. One half to one and one-fourth units.*

Assistant Professor Balke.

103a. Advanced Analytical Chemistry.—Special topics, lectures, with or without laboratory. *One to five times a week; second semester. One-half to one and one-quarter units.*

Dr. Smith.

Prerequisite: Chemistry 5b, 9a, 9b, 14, 31, 33.

103b. Special Topics in Inorganic Chemistry.—Lectures and Seminar. Subject for 1913-1914: The Investigations and Theories of Werner. Werner, *Neuere Anschauungen auf dem Gebiete der unorganischen Chemie,* together with assigned reading from later publications. *Twice a week; first semester. Three-quarters unit.* Dr. Smith.

Prerequisite: Chemistry 9a, 9b, 14.

103c. Special Topics in Inorganic Chemistry.—Seminar. Subject for 1913-1914: The Determination of Atomic Weights. *Twice a week; second semester. Three-quarters unit.* Assistant Professor Balke.

103d. Advanced Qualitative Analysis.—Methods of separating qualitative reagents; reactions of some of the less common elements. Designed especially for those intending to teach qualitative chemistry. Lectures, with or without

laboratory. *One to three times a week; first semester. One half to one unit.* Dr. Weber.

104. Advanced Organic Chemistry.—A seminar and lecture course. Among the chapters discussed are: Kekule's Linking Theory, Stereochemistry, Stearic Hindrance, Molecular Rearrangements, Tautomerism, etc. Special attention is given to the application of modern physical chemistry to the study of organic problems, especially the application of chemical kinetics to Tautomerism and the application of physical properties to the determination of chemical structure. *Twice a week; both semester. Three-quarters unit.* Dr. Derick.

104a. Advanced Organic Chemistry.—This course consists of two lectures a week with assigned reading and is especially recommended to students doing research work in this subject. Special attention is given to the detailed study of recent research methods in such fields as: Condensation, carbohydrates, fermentation, and enzyme action, the purine group, the proteins, the relation of color to chemical constitution, alkaloids, etc. The chapters may be varied from year to year. *Twice a week; first semester. Three-quarters unit.* Alternates with 104. Dr. Derick.

104b. Advanced Quantitative Organic Analysis.—The quantitative chemistry of the proteins, alkaloids, glucosides, volatile oils, and other constituents of animal and vegetable tissues. Plant analysis. Toxicological analysis. Concludes with a study of the general methods, chemical and physical, of organic analysis. Lectures and seminar. May be accompanied by laboratory work on a selected group of compounds. *Twice a week; both semesters. Three quarters unit.* Dr. Beal.

105. Advanced Physiological Chemistry.—Selected portions of physiological chemistry not covered by Chemistry 15. *Twice a week; second semester. Three-quarters unit.* Dr. Mac Arthur.

105a. Advanced Physiological Chemistry.—Special investigations. Laboratory. *Two to five times a week; second semester. Three-quarters unit.* Dr. Mac Arthur.

105b. Advanced Physiological Chemistry.—A critical consideration of recent contributions of importance in the field of physiological chemistry. *Twice a week; both semesters. Three-quarters unit.* Dr. Mac Arthur.

106. Animal Chemistry Nutrition.—A lecture course consisting of a critical study of the recent advances in the chemistry of nutrition of the lower animals, and a detailed study of the chemistry of the functional products, such as flesh, fat, milk, wool, etc., of the more common domesticated animals. *Twice a week; both semesters. Three-quarters unit.*

Professor Grindley.

107. Calorimetry.—Standards and methods. *One to three times a week; both semesters. One half to one unit.*

Professor Parr.

108. Metallography.—The constitution and microstructure of metals and alloys; the relations between their properties, chemical and mechanical treatment, and structure. Lectures; reading, laboratory. *Twice a week; second semester. Three-quarters unit.*

Assistant Professor McFarland.

109. Advanced Industrial Chemistry.—Seminar. A detailed study of some of the more important chemical industries, and the development and chemical control of processes. *Twice a week; both semesters. Three-quarters unit.*

Assistant Professor McFarland.

Prerequisite: Chemistry 6, 9, 14, 21, or equivalent.

110. Water Supplies.—A study of the sources of contamination of water supplies and the purification of water for potable or technical use. *One to five times a week; both semesters. One half to one and one-quarter units.*

Professor Bartow.

111. Research.—*Once a week; both semesters.*

Physical and Electrochemistry.—Assistant Professor Washburn, Dr. MacInnes.

Inorganic Chemistry.—Assistant Professor Balke, Dr. Smith, Dr. Weber.

Analytical Chemistry.—Dr. Smith.

Food Chemistry.—Dr. Beal.

Organic Chemistry.—Professor Noyes, Dr. Derick, Dr. Thorp.

Water Chemistry.—Professor Bartow.

Physiological Chemistry.—Dr. Mac Arthur.

Animal Chemistry Nutrition—Professor Grindley.

Industrial Chemistry.—Professor Parr, Assistant Professor McFarland.

Courses for Graduates and Advanced Undergraduates

5c. Food Analysis.—The elements of quantitative organic analysis, with special reference to the examination of food and drug products. *Five times a week; second semester.* Dr. Beal.

6.* Chemical Technology.—This is a course of lectures comprising a study of technological chemistry as illustrated in those industries having a chemical basis for their principal operations and processes. *Thorp's Industrial Chemistry* is used as a guide. *Twice a week; second semester.* Professor Parr.

7.* Metallurgy.—A general course in metallurgical processes. Lectures and assigned reading. *Three times a week; first semester.* Professor Parr.

8. Iron and Steel Analysis.—Analyses are made of all the constituents by both rapid, or technical and standard methods. *Three times a week; second semester.* Dr. Smith.

9a. Organic Synthesis.—Laboratory work for students of the chemical course, in ultimate organic analysis and the preparation and study of typical organic compounds, to accompany Chemistry 14. *Twice a week; first semester.* Dr. Derick, Dr. Thorp.

9b. Organic Synthesis and Analysis.—Continuation of 9a, to accompany Chemistry 14. *Twice a week; second semester.* Dr .Derick. Dr. Thorp.

10a. Study of Water Supplies.—Lectures on history, sources, contamination, and standards of purity of potable waters and waters for industrial purposes, together with practice in analytical methods. *Three times a week; second semester.* Professor Bartow.

13b. Advanced Agricultural Analysis.—This course is offered to students who wish to specialize in agricultural chemistry or agricultural experiments. Applied quantitative analysis. The analyses of fungicides, limestone, phosphate rock, fuel and water, determination of the alkali metals, special methods of agricultual analysis. *Threadwell-Hall, "Analytical Chemistry", Vol. II. Five times a week; second semester.* Dr. Beal.

*Certain inspection trips will be arranged in connection with courses 6 and 7. Students registering in these courses should take into consideration the expense involved, which will approximate $15.00 for each course.

14. Organic Chemistry.—This course consists of lectures and recitations upon the fundamental principles and more important compounds of organic chemistry. *Noyes's Organic Chemistry.* This course must be accompanied by Chemistry 9a and 9b. *Three times a week; both semesters.*

Professor Noyes.

15. Physiological Chemistry.—This course is designed for students desiring a knowledge of the fundamental principles of physiological chemistry. *Five times a week; first semester.* Dr. Mac Arthur.

15a. Metabolism and Nutrition.—Metabolism; activities of gastro-intestinal tract; enzymes; inorganic nutrition, etc. *Twice a week; second semester.* Dr. Mac Arthur.

21. Qualitative Organic Analysis.—A course of laboratory practice for advanced students in systematic methods for the identification of organic compounds. *Twice a week; first semester.* Dr. Derick.

22. Animal Chemistry Nutrition.—A course for the detailed study of the chemical composition of animal products and feeding stuffs. *Three to five times a week; first or second semester.* Professor Grindley.

27. Qualitative Analysis of the Rare Elements.—*Three times a week; second semester.*

Assistant Professor Balke.

31. Elementary Physical Chemistry.—*Three times a week; second semester.* Assistant Professor Washburn.

32. Elementary Physical Chemistry.—A laboratory course to accompany course 31. *Twice a week; second semester.* Dr. MacInnes.

35. Electrochemistry.—Intended for students going into technical work. The study of patents is made an important feature of the course, each student being required to collect, study and report upon the more important patents in some selected industry. *Allmand's Applied Electrochemistry.* See also Chemistry 102b. *Three times a week; first semester.*

Dr. MacInnes.

66. Technology of Gases.—The laboratory work includes calorimetry, photometry, and some of the more usual methods of analysis. *Once a week; second semester.* Professor Parr.

68a. Analysis of Glasses and Glazes.—For students in ceramics. A study of methods and practice on special prob-

lems connected with the pottery industry. *Three times a week; first semester.* Dr. SMITH.

70. ADVANCED ASSAYING AND ORE TESTING.—The assay of complex ores of platinum, tin, and copper; bullion assay, free milling, amalgamation, and cyaniding tests. *Twice a week; second semester.* Assistant Professor MCFARLAND.

72. PAINTS, OILS, TURPENTINES, VARNISHES AND PROTECTIVE COVERINGS FOR WOOD AND METALS.—Lectures and laboratory. *Twice a week; first semester.* Professor PARR.

76. CALORIMETRY OF FUELS.—An advanced course in the study of methods for determining the heat values of solid, liquid, and gaseous fuels. *One to three times a week; both semesters.* Professor PARR.

77. COMPOSITION AND CLASSIFICATION OF COAL.—A lecture and reading course on the composition of coal with reference to its classification, changes in composition, weathering, spontaneous combustion, formation of mine gases, etc. *Once a week; second semester.* Professor PARR.

78. METALLOGRAPHY.—Lectures, reading and laboratory work on the constitution and microstructure of metals and alloys and on the relations between their properties, chemical and mechanical treatment and structure. *Twice a week; second semester.* Assistant Professor MCFARLAND

93. JOURNAL MEETING.—For seniors and graduates. *Once a week; both semesters.*

ENTOMOLOGY

The prerequisite for graduate work in entomology is a year's work in college zoology, or a half a year's work in zoology and a year's work in botany. Entrance upon major work in entomology requires the equivalent of Entomology 2 and 3. Courses 108 and 109 require 8 and 9 respectively.

Courses for Graduates

102. RESEARCH IN THE MORPHOLOGY AND EMBRYOLOGY OF INSECTS. *Twice a week; both semesters. One or two units.* Assistant Professor FOLSOM.

103. RESEARCH IN FAUNISTIC AND ECOLOGICAL ENTOMOLOGY. *Once or twice a week; both semesters. One or two units.* Professor FORBES.

108. Research in Economic Entomology. *Once or twice a week; both semesters. One or two units.* Professor Forbes.

109. Research in Systematic Entomology. *Twice a week; both semesters. One or two units.*

Assistant Professor MacGillivray.

Courses for Graduates and Advanced Undergraduates

2. General Entomology.—Field entomology; morphological and physiological entomology; the collection and preservation of specimens; laboratory studies of typical insects; the recognition of adaptive structures and their utilities. (This course and course 3 form a year's work, covering the whole field. Either may be taken independently of the other.) *Five times a week; first semester.*

Assistant Professors Folsom and MacGillivray.

3. General Entomology.—The classification and determination of insects; the study of life histories in the insectary and by field observation; the collection of information with respect to the ecological relations of insects. *Five times a week; second semester.* Assistant Professor Folsom.

5. Introduction to Research.—Library, language, manuscript, and advanced laboratory work on assigned topics. *Three to five times a week; first or second semester.*

Professor Forbes, Assistant Professors Folsom and MacGillivray.

7. Systematic Entomology.—The external anatomy of insects; the terminology of the parts; identification of specimens representing as many as possible of the major groups. *Five times a week; first or second semester.*

Assistant Professor MacGillivray.

8. Economic Entomology.—Field, laboratory, insectary, library, and manuscript work, with practice in some of the special operations of economic entomology. Preparation for individual study of other classes of insect pests. *Three times a week; both semesters.* Assistant Professor Folsom.

9. Advanced Systematic Entomology.—The identification of the characters upon which genera and species are based. *Five times a week; first or second semester.*

Assistant Professor MacGillivray.

10. Taxonomy of Immature Insects. *Five times a week; first semester.* Assistant Professor MacGillivray.

11. Classification of the Coccidae.—Methods of preparing scale insects for study, the identification of genera and species, and discussion of their morphology, metamorphosis, and phylogeny. *Five times a week; second semester.*

Assistant Professor MacGillivray.

12. Current Literature.—Reports and discussion upon assigned topics; presentation and discussion of contents of recent entomological publications, and of results of personal research. *Once a week; both semesters.*

13. Medical Entomology.—Primarily for advanced students preparing for medicine. A study of insects as related to the transmission of disease. Laboratory observations and experiments, and written reports, with discussions upon literature of the subject. Methods of controlling insects capable of transmitting diseases. *Three times a week; first or second semester.* Assistant Professor Folsom.

14. Advanced Economic Entomology.—Personal work, under direction, in the insectary, field, and library, with assigned problems in economic entomology involving observation, experiment, and inference, note making, record keeping, and the preparation of manuscript. Intended to prepare advanced students for immediate service as entomologists in experiment stations and other state and government positions. Advantage will be taken of the operations and practical problems of the State Entomologist's Office, so far as available for the purposes of this course. *Twice a week; first or second semester, and six weeks of summer vacation.*

Professor Forbes.

GEOLOGY

The first prerequisite for graduate work in Geology is the equivalent of the complete undergraduate offerings in that branch of the subject in which specialization is desired. Those who wish to specialize in paleontology should have, in addition, at least an elementary knowledge of Systematic Zoölogy; those who wish Physical Geography should have a fairly thorough knowledge of General Physics and Chemistry; and those who expect to pursue work in Petrography and Economic Geology should be well grounded in General Physics, Inorganic Chemistry and the elements of Physical Chemistry. All

graduate students should be sufficiently acquainted with German and French to be able to read the journals printed in these languages.

Courses for Graduates

101. ADVANCED CRYSTALLOGRAPHY.—This course is intended to familiarize the student in chemistry or mineralogy with the methods used in measuring, projecting and calculating crystal forms, and determining the physical properties of crystalized bodies. *Three to five times a week; both semesters.* Associate Professor BAYLEY.

102. PETROGRAPHY.—Lectures and laboratory work on the crystalline and fragmental rocks including identification of types, classification and relationships. *Three to five times a week; both semesters.* Associate Professor BAYLEY.

105. INVERTEBRATE PALEONTOLOGY.—A course devoted to the study of a group of invertebrate fossils, or of the fossils of a special geological system; their geographic distribution and geologic range with reference to stratigraphy. Largely individual work. *Three to five times a week.*
Assistant Professor SAVAGE.

106. FIELD AND LABORATORY COURSE.—A course consisting of a systematic study of the geology and paleontology of a selected area in Illinois. A carefully prepared report on the geology of the region, based on the data collected in the field, is required. *Three to five times a week.*
Assistant Professor SAVAGE.

107. AREAL AND STRUCTURAL GEOLOGY.—Individual work on some area exhibiting important structural or economic features. *Once a week.* Associate Professor BAYLEY.

124. ADVANCED PHYSIOGRAPHY.—Individual work on field problems, with study and discussion of the more advanced literature of physiography and geomorphology. *One to three times a week.* Dr. RICH.

Courses for Graduates and Advanced Undergraduates

6. PHYSICAL AND OPTICAL MINERALOGY.—An introduction to the course in Petrography. The physical and optical properties of minerals are discussed with special reference to symmetry. The larger portion of the work is devoted to

the study of polarized light and its practical use in identifying the rock-forming materials. *Five times a week; second semester.* Associate Professor BAYLEY

7. PETROGRAPHY.—The principles learned in course 6 are applied to the study of rocks. Lectures describe the different types of these rocks and discuss their origin and classification. In the laboratory a representative suite of specimens is studied in the hand specimen and thin section. *Five times a week; first semester.* Associate Professor BAYLEY.

9. PALEONTOLOGY.—A study of invertebrate fossils, their classification and relationships. Instruction is given in the identification of the fossils, and in the finding and use of the literature of the subject. *Five times a week; first semester.* Assistant Professor SAVAGE.

15. STRUCTURAL GEOLOGY.—The arrangement of the rocks which form the earth's crust and their distribution on its surface; mountains; faults; folds; other diastrophic phenmena. *Five times a week; first semester.* Associate Professor BAYLEY.

16. STRATIGRAPHY.—This course follows course 9, and is a study of principles of classifications, of rock formations, of the methods and criteria employed in correlation, of the characterstic invertebrate faunas of the successive geologic formations and their distribution, and of the use of these in the interpretation of stratigraphy. *Five times a week; second semester.* Associate Professor SAVAGE.

HOUSEHOLD SCIENCE

Students who wish to do graduate work in Household Science will find it to their advantage to specialize in either the scientific or the economic phases of the subject. In either case they should be able to offer an equivalent for twenty-four hours of household science given in the University of Illinois, with a minimum of two years of chemistry, including organic chemistry, a year of biological science, and a year of either economics or sociology.

Courses for Graduates

101. HOME ECONOMICS.—A study of the origin and development of home economics, with particular reference to

its industrial, educational, and sociological aspects. *Twice a week; both semesters. One unit.* *Professor* BEVIER.

102. SPECIAL INVESTIGATIONS.—Problems in the application of the principles of bacteriology, chemistry, and physiology to the ordinary processes used in preparation of food; problems in nutrition. *Twice a week; both semesters. Two units.*

Prof. BEVIER, Asst. Prof. GOLDTHWAITE, Miss WHEELER.

Courses for Graduates and Advanced Undergraduates

4. FOOD AND NUTRITION.—An application of the principles of pure science to the problems of food and nutrition. The problems may be physiological, chemical or bacteriological. *Five times a week; first semester.*

Prof. BEVIER, Asst. Prof. GOLDTHWAITE, Miss WHEELER.

5. DIETETICS.—The work in dietetics includes the following topics: The principles of diet, the relation of food to health; influence of age, sex and occupation on diet; the construction of dietaries; dietetic treatment of certain diseases. *Three times a week; both semesters.*

Assistant Professor GOLDTHWAITE.

MATHEMATICS

Library Facilities.—The mathematical library of approximately 3,000 volumes, is in a room in the Natural History Building, to which all graduate students have easy access.

In addition to forty Mathematical journals kept in the department seminar room, the general University library receives regularly about 2,400 periodicals, a considerable number of which are partly devoted to mathematics. We mention in particular the proceedings of various scientific societies such as, for example: Les Comptes Rendus de l'Académie des Sciences (Paris); Sitzungsberichte der k. Akademie (Berlin); Nachrichten der Gesellschaft der Wissenschaften zu Göttingen; Transactions of the Royal Society (London); etc.

Models Apparatus, etc.—The department has in its possession a collection of models for instruction and research in analysis, geometry, and kinematics. This collection contains a large number of plaster of paris casts from the famous collections of Schilling and Wiener, illustrating the properties of surfaces of the first four orders and of the differential prop-

erties of surfaces in general. A considerable number of string models are available for demonstrating the properties of ruled surfaces and space curves; other models of wire and celluloid serve to make clear the peculiarities of space curves, in particular those of the third order. Plaster models, some of which have been originated and constructed by students under the guidance of instructors at the University, illustrate important points in the theory of functions. The collection also contains a number of kinematic models illustrating the generation of trochoids of various kinds, inversors, etc.

The department possesses a collection of computing machines, slide rules of various kinds, planimeters, integraphs, a harmonic analyser, etc.

Previous Training.—Students entering upon graduate study in mathematics should have had a course in calculus extending through the year, and a course in the theory of equations, or in differential equations. They should be able to read German and French sufficiently to consult the mathematical literature in these languages.

Courses for Graduates

100. Seminar.—*Three times a week; one to two units; both semesters.* Professor Townsend, Professor Miller, Associate Professor Rietz, Assistant Professor Sisam, Assistant Professor Shaw, Assistant Professor Emch.

101. Functions of Real Variables.—An introduction to the theory of functions of real variables, making use of the general principles of the theory of assemblages. *Three times a week; one unit; both semesters.* Professor Townsend.

104. Expansions in Fundamental Functions.—This course develops the theory of integral equations far enough to arrive at methods of expansion of arbitrary functions in terms of the characteristic functions of a given nucleus. It includes applications of Green's functions, Potential functions, Fourier series, series of Legendrians, of Bessel functions, and others; the study of differential equations of physics under given boundary conditions; the inversion of definite integrals. Prerequisite Math. 16 or 22a. *Three times a week; one unit; both semesters.*

[Not given in 1913-14.]

Assistant Professor Shaw.

110. Elliptic Functions.—The elements of the theory of elliptic functions with applications to geometry and mechanics. Introduction to the theory of the elliptic modular functions. *Three times a week; one unit; both semesters.*

Assistant Professor Emch.

[Not given in 1913-14.]

111. Automorphic Functions.—The first semester will be devoted mostly to the group-theoretic side of the theory; the second semester will be concerned with the function-theoretic developments and applications. *Three times a week; one unit; both semesters.*

Assistant Professor Emch.

113. Theory of Linear Differential Equations.—*Three times a week; one unit; both semesters.*

Dr. Crathorne.

[Not given in 1913-14.]

120. Elementary Theory of Groups.—The study of the groups which present themselves in arithmetic, geometry, and trigonometry is followed by a determination and study of those which can be represented with a small number of letters. The latter part of the course is devoted to abstract root theory and the Galois theory of equations. *Three times a week; one unit; both semesters.* Professor Miller.

[Not given in 1913-14.]

121. Theory of Groups.—Second course. This course presupposes about one year's work in group-theory. The early part of the course is given to the consideration of recent advances and methods along these special lines, and the latter part to research. *Three times a week; one unit; both semesters.* Professor Miller.

124. Theory of Numbers.—The principal subjects considered in this course are: congruences, Kronecker's modular systems, quadratic residues, quadratic forms and algebraic numbers. *Three times a week; one unit; both semesters.*

Dr. Wahlin.

129. Theory of Statistics.—The general methods of statistical investigation, the application of the theory of probability to statistical data, the fitting of curves to observation, interpolation, theory of errors, and the mathematical theory of variability and correlation, the application of the principles developed to problems in economics, sociology, and

biology. *Three times a week; one unit; both semesters.*
Associate Professor RIETZ.

130. INVARIANTS AND HIGHER PLANE CURVES.—This course includes the general theory of algebraic curves, together with the application of the theory of invariants to higher plane curves. Special study is made of curves of the third and fourth order. *Three times a week; one unit; both semesters.* Assistant Professor SISAM.

131. ALGEBRAIC SURFACES.—In this course are considered the application of homogenous coördinates and the theory of invariants to geometry of three dimensions, and also the general theory of surfaces, together with the special properties of surfaces of the third and fourth order. *Three times a week; one unit; both semesters.*
Assistant Professor SISAM.

[Not given in 1913-14.]

135. DIFFERENTIAL GEOMETRY.—Applications of the calculus to the general theory of curves and surfaces based primarily on the use of Cartesian coördinates. Relation of the theory of surfaces to the theory of invariants of a pair of quadratic differential forms. *Three times a week; one unit; both semesters.*

[Not given in 1913-14.]

141. VECTOR METHODS.—Principles of the algebras of quaternions, space analysis, and dyadics. Developments of theorems of differentiation and integration. Applications to Rational Mechanics, Elasticity, Hydrodynamics, Electrodynamics. Prerequisite Math. 16. *Three times a week; one unit; both semesters.* Assistant Professor SHAW.

142. GENERAL ALGEBRA.—Theory of linear associative algebra or hypercomplex numbers, with particular study of the systems useful for the geometry and physics of N dimensions. Applications to relativity theories, and to general differential and integral invariants. Theory of linear operators and functional equations; applications to general analysis, integro-differential equations, infinite systems. General theory of operators; applications to general invariant theories. Prerequisite Math. 33. *Three times a week; one unit; both semesters.* Assistant Professor SHAW.

[Not given in 1913-14.]

Courses for Graduates and Advanced Undergraduates

10. Theory of Equations and Determinants.—Some of the fundamental properties of an algebraic equation in one unknown; the solutions of systems of simultaneous equations; theory of a system of linear equations; some fundamental properties of determinants. *Three times a week; second semester.* Professor Miller.

16. Differential Equations.—This course embraces the following topics: General linear equations with constant coefficients, special forms of differential equations of higher order, integration in series, etc. *Twice a week; first semester.* Professor Townsend.

19. Solid Analytical Geometry.—A general review of the equations of the plane and the right line in space and the more general properties of surfaces of the second degree. The classification and special properties of quadrics, and a brief introduction to the theory of surfaces in general. *Three times a week; second semester.* Assistant Professor Sisam.

20. Calculus of Variations.—This course has for its aim merely to acquaint the student with those elements of the science which are most needed in the study of the higher subjects of mathematical astronomy and physics. *Three times a week; second semester.* Dr. Crathorne.

[Not given in 1913-14.]

21. Method of Least Squares.—The fundamental principles of the subject. The following topics are studied: Law of probability and error, adjustment of observations, precision of observations, independent and conditional observations, etc. *Twice a week; first semester.*

Assistant Professor Stebbins.

22. Partial Differential Equations.—This course deals with the integration and determination of the integration constants of such partial differential equations as arise in the study of such subjects as the flow of heat, the vibration of strings, plates, etc., and electricity. *Twice a week; second semester.* Professor Townsend.

24. Functions of a Complex Variable.—A general introduction to the theory of function of a complex variable. *Three times a week; both semesters.* Professor Townsend.

[Not given in 1913-14.]

27. Projective Geometry.—Fundamental concepts; anharmonic ratio; projective pencils and ranges; projective transformations and groups, theory of conics and quadric surfaces; pencils and ranges of conics; quadratic transformations and projective theory of cubics; application to mechanics. *Three times a week; both semesters.* Dr. Crathorne.

31. Actuarial Theory.—The application of probability to life contingencies, the construction and graduation of mortality tables, the elements of fire insurance and the calculation of premiums and reserves for various types of insurance. *Three times a week; first semester.*

Associate Professor Reitz.

[Not given in 1913-14.]

32. History of Mathematics.—A general view of the historical development of the elementary subjects and an outline of the rise and growth of the higher mathematics chiefly in the nineteenth century grouped about the persons most influential in this development. Lectures and reports on assigned reading. *Twice a week; second semester.* Dr. Lytle.

[Not given in 1913-14.]

33. Modern Algebra.—This course includes a consideration of the following topics: theory of matrices; system of linear equations; bilinear and quadratic forms; properties of polynomials; algebraic invariants; and elementary divisors. *Three times a week; both semesters.* Dr. Börger.

40. Fundamental Concepts of Mathematics.—Development of the number concept; concepts of unity; aggregate, order and correspondence; irrationals and limits, transcendence of e and n; parallel axiom and non-euclidian geometries; ruler and compass constructions; function; logic of mathematics. *Twice a week; second semester.* Dr. Lytle.

PHYSICS

The prerequisite for graduate work in physics is a college course in general physics with a year's laboratory course in introductory physical measurements. The student who is to do major work in physics should also have had additional courses in physics or teaching experience, unless the training in his minor subjects, mathematics or chemistry, has been strong and complete. He should also have a knowledge of French and German sufficient to use references in these lan-

guages. The courses named below are those open for candidates for the Master's or Doctor's degree. A large part of the last year's work of the candidate for the Doctor's degree is investigational, along either the experimental or the theoretical side of physics. In addition to these major graduate courses, the courses in elementary dynamics, heat, light, electrical measurements, and introductory electrical theory, are arranged with certain additions for graduate credit. The "intermediate" courses on heat, light and electricity and magnetism, may be offered by students making a minor in physics.

Courses for Graduates

121. Recent Advances in Physical Science.—Lectures illustrated by experiments on the more recent developments of physics. Students regularly registered in this course are required to make written reports giving an original discussion of one or more of the topics discussed during the semester. *Once a week; first semester. One-half unit.*

Assistant Professor Knipp.

123. Sound.—Lectures and recitations. Rayleigh's *Sound*, Auerbach's *Akustik* and Barton's *Sound* are used as reference texts. *Twice a week; both semesters. One unit.*

Assistant Professor Watson.

124. Conduction of Electricity Through Gases.—Laboratory problems with readings and discussions on the electrical conductivity of gases, ions and ionisation, the effect of a magnetic field, the motion of ions, spark discharge, cathode rays, Roentgen rays, canal or positive rays, and related phenomena of radioactivity. *Three times a week; both semesters. One to two units.* Assistant Professor Knipp.

126. Physics Colloquium.—Weekly meetings of the instructors and advanced students of the department for the presentation and discussion of papers on current problems in Physics. Many of these papers are on investigations in progress in the laboratory and experimental demonstrations are used. Attendance on this colloquium is expected of all the graduate students though it is not registered, except in the cases of those making special reports on original investigations. *Once a week; both semesters. One-quarter to one-half unit.*

127. Electron Theory.—The theories of the constitution of the atom, and the phenomena of the emission and absorption spectra will be studied from a theoretical point of view. This course will have the character of a seminar. The course should be of especial interest to students in advanced chemistry. *Twice a week. One-half to one unit.*

Assistant Professor Kunz.

131. Investigation of Special Problems.—An advanced course in laboratory or in design and calculation. A problem is chosen and worked out with the advice and direction of the instructor. *Two to four times a week; both semesters. One to two units.*

Professor Carman, Assistant Professors Knipp, Watson, Schultz, Kunz, and Dr. Williams. .

132. Mathematical Physics.—Special phases in theoretical physics.

(a) Dynamics.—First part: dynamics of a material system, determination of the center of gravity, moment of inertia and potential, potential-theory, with applications in celestial mechanics. Second part: the principle of least action, Langrange's equations, the theory of the top and its applications. The fundamental equations of elasticity, hydrodynamics, of the electromagnetic field and the second principle of thermodynamics for reversible processes will be deduced from the principle of least action. *Three times a week; both semesters. One to one and one-half units.*

Assistant Professor Kunz.

(b) Electrodynamics.—Lectures and collateral reading on the principles of electrodynamics. Jean's Mathematical Theory of Electricity and Magnetism is used especially for the sake of the problems, a large number of which will be solved. The potential theory is the basis of the course which involves as mathematical tools, spherical harmonics, conjugate functions and some theorems of the vector analysis. A large number of capacities, coefficients of self and mutual induction are determined. Special attention is paid to the theory of absolute electrical measurements and to the condenser discharge with its application in wireless telegraphy. Maxwell's theory is studied with some applications in optics, such as the optical properties of metals. The course ends with a general

review of the modern modifications of Maxwell's theory, that is, the theory of relativity and the electromagnetic emission theory of light. This course is continued in the following year in course 132d. Assistant Professor KUNZ.

[Not given in 1913-14.]

(c) THERMODYNAMICS.—Fundamental principles with applications to physical and chemical phenomena. Lectures; recitations. *Three times a week; both semesters.*

Assistant Professor KUNZ.

[Not given in 1913-14.]

(d) THEORY OF ELECTRICAL OSCILLATIONS AND CYLINDRICAL HARMONICS.—The conduction of heat and electricity through cylinders and cables leads to the introduction of cylindrical harmonies of real arguments. Their mathematical properties will be studied. Electrical oscillations along parallel wires, the vibrations from a Wertz oscillator and from antenna, the resonance phenomena between sending and receiving stations, the propagation of electrical waves over the surface of the earth and their absorption will be studied in the first part of the course. Cylindrical and spherical harmonies will then be used for the solution of special problems, such as the resistance and self induction of wires. Applications of cylindrical harmonies will finally be made for phenomena in optics and radiation of light and heat. *Four times a week; both semesters. One to two units.*

Assistant Professor KUNZ.

133. SEMINAR.—*Three or five times a week; both semesters. One to there units.*

Professor CARMAN, Assistant Professors KNIPP, WATSON, SCHULZ, KUNZ.

Courses for Graduates and Advanced Undergraduates

4. ELECTRICAL AND MAGNETIC MEASUREMENTS.—Laboratory exercises with discussions and recitations. The course extends throughout the year. It is recommended to those wishing a comprehensive course in exact electrical and magnetic measurements. *Twice a week; both semesters.*

Assistant Professor KNIPP, Mr. SMITH, Mr. RANDOLPH.

14. DYNAMICS AND ADVANCED GENERAL PHYSICS.—An introduction to theoretical physics involving the use of the cal-

culus. The first semester is devoted to dynamics with an introduction to the mechanical theory of heat. *Three times a week; first semester.*

20a. LIGHT.—Special phenomena; modern theories; reading in texts of Drude, Wood, and Preston. Lectures; recitations. *Twice a week; first or second semester.*

Assistant Professor SCHULZ.

20b. LIGHT.—Light measurements. Laboratory. *Two to five times a week; first or second semester.*

Assistant Professor SCHULZ.

23. SOUND.—Lectures; recitations; experiments. *Twice a week; second semester.* Assistant Professor WATSON.

25. HEAT.—A course of text-book, lecture and laboratory exercises. *Twice a week; second semester.*

28. HISTORY OF PHYSICS.—Lectures on the leaders in physics from Galileo to J. J. Thomson, with a discussion of their contributions to the development of physics. Written reports on assigned reading are required. *Once a week; second semester.* Professor CARMAN.

29. ELECTRICAL OSCILLATIONS.—Oscillating currents for both low and higher frequencies with particular attention in the second semester to the theory of wave telegraphy and telephony. *Three times a week; both semesters.*

Professor CARMAN.

[Not given in 1913-14.]

30a. INTRODUCTION TO THEORETICAL ELECTRICITY.—A course of lectures and recitations discussing the phenomena with elementary calculus methods, and with occasional lecture-room demonstrations. References: Foster and Porter's Electricity and Magnetism, Thomson's Elements of Electricity and Magnetism. *Three times a week; second semester.*

Assistant Professor KNIPP.

30b. ELECTRICITY AND MAGNETISM.—A course of electrical measurements, including self and mutual induction, standardization and calibration work, also problems in magnetism, etc. *Two, three or five times a week; first or second* semester. Dr. WILLIAMS.

31. SPECIAL PROBLEMS IN ADVANCED PHYSICAL MEASUREMENTS.—*Two or three times a week.*

Professor CARMAN, Assistant Professor KNIPP and Dr. WILLIAMS.

PHYSIOLOGY

The prerequisite for graduate work in Physiology is two years' work in chemistry and two in biology. The biology should include at least one year in the fundamentals of zoölogy and embryology.

Course for Graduates

103. RESEARCH.—Facilities are offered in the physiological laboratory for special lines of investigation. *Once a week; both semesters. One or two units.*

Assistant Professor BURGE.

Courses for Graduates and Advanced Undergraduates.

1. HISTOLOGY.—This course includes a study of the fundamental mammalian tissues, and the microscopic anatomy of the organs. Lectures and laboratory. *Five times a week; first semester.* Assistant Professor BURGE and Dr. BEARD.

2. PHYSIOLOGY.—This course includes a study of the physiology of nerve and muscle, circulation, respiration, secretion, digestion and metabolism. Lectures and laboratory. *Five times a week; second semester.*

Assistant Professor BURGE and Dr. BEARD.

5. SPECIAL PHYSIOLOGY.—This course includes work in the physiology of special sense, optics and advanced work in circulation, blood and respiration. Lectures and laboratory *Five times* a *week; both semesters.*

Assistant Professor BURGE.

7. JOURNAL CLUB.—*Once a week; both semesters.*

Assistant Professor BURGE.

ZOOLOGY

The equipment of the department includes the usual apparatus, microscopes, microtomes, paraffin baths, demonstration material, and reagents. The various special laboratories are equipped with special apparatus and demonstration material in accordance with their particular needs. Provision is made for meeting such special demands for material, apparatus, and literature as may arise in connection with individual work.

The University Museum contains a valuable series of mounted vertebrates, of Ziegler embryological models, and of

alcoholic material in all groups; these are available as needed for either teaching or research.

The extensive collections and library of the Illinois State Laboratory of Natural History are freely available to advanced students. They are unusually rich in that which pertains to fresh water biology. The private library and collection of the head of the department, which contain much material on invertebrate morphology and on parasitism are also placed at the disposal of graduate students.

Two years of college work in Zoology making a total of, at least, sixteen semester hours, are the ordinary preliminary requirements for entering upon graduate study in this department. Under special circumstances advanced work in closely allied subjects may be accepted in lieu of the fourth semester work in Zoology. Even when Zoology is chosen for a minor the courses listed for graduates and undergraduates to be acceptable, must be preceded by at least one full year's undergraduate work in Zoology. Work done at other institutions will be evaluated on conference with the head of the department.

Courses for Graduates

102. Selected Topics from Vertebrate Morphology.—Two lectures a week and required reading. *First semester. One unit.* Professor Kingsley.

107. Parasitology.—The structure and life history of animal parasites, together with their relations to disease. Conferences and assigned reading with laboratory demonstrations. *Two or three times a week; both semesters. One unit.* [Given in 1914-1915 and in alternate years.] Professor Ward.

113. Experimental Zoology.—Assigned problems in experimental embryology, regeneration, variation and heredity. The problems are individual and their scope is more or less extended to suit individual needs. *Two to five times a week; both semesters. One to two units.*

Associate Professor Zeleny.

117. Faunistic Zoology.—Problems in texonomy, distribution and ecology, accompanied by field work, conference and lectures. The work of this course is favored by a natural history survey of the state now in progress at the University. Students have the advantage of the collections, library, apparatus, and operation of this survey as an aid to

their personal studies. *Twice a week; both semesters. One unit.* Associate Professor Smith, Dr. Adams.

127. Theories of Animal Phylogeny.—Relations of various groups of animals; signification of so-called intermediate forms; study of invertebrate larval forms and of theories of descent based on them. Lectures; assigned readings; laboratory. *Once or twice a week; both semesters. One unit.* [Given in 1913-1914 and alternate years.]

Professor Ward.

121. Individual Research Courses.—

(a) Zoological problems. Professor Ward.

(b) Faunistic and systematic Zoölogy.
Associate Professor Smith.

(c) Animal Ecology and Zoogeography. Dr. Adams.

(d) Vertebrate Embryology.
Assistant Professor Carpenter.

(e) Structure and Development of the Nervous System.
Assistant Professor Carpenter.

(f) Experimental Zoology.
Associate Professor Zeleny.

Courses for Graduates and Advanced Undergraduates

3. Microscopical Technique and General Vertebrate Embryology.—Theory and practice of microscopical technique, followed by the study of vertebrate embryos in early stages of development. In the laboratory the student is first trained in the ordinary methods of fixation, embedding, section cutting, staining and mounting. Embryological material will be prepared and used later in connection with the study of introductory embryology which completes the course. *Three times a week; first semester.*

6. Vertebrate Organogeny.—A continuation of Course 3 intended for medical students and others who desire an intimate acquaintance with the development of the organs of the vertebrate body. The course includes lectures, assigned readings in a textbook of human embryology and laboratory studies on embryos of the chick and pig. *Three times a week; second semester.*

9. Animal Ecology.—Introductory study on the relation of animals to their natural environment. Special stress is

laid upon the processes of change in environment and their influences upon animal life. Field trips are made for a study of the conditions under which the local fauna lives, and for instruction inmethods of observations and the making of notes and collections. In the laboratory the specimens are collected and observed and determined, reports are prepared, and a working knowledge of the literature is acquired. Principal attention is given to insects, mollusks, reptiles, amphibians, and fishes. *Three times a week; second semester.*

Dr. ADAMS.

11. PRINCIPLES OF ZOOGEOGRAPHY.—An introduction to the study of the geographical distribution of animals, in which particular attention is given to the faunas of North America and of Illinois. The fauna is considered in its relation to the complete environment—climate, physiography, geology, vegetation, etc.,—and from the standpoint of its origin and its dynamic relations; laboratory work on maps, and field excursions. *Two or three times a week;* Saturday excursions to be arranged; *first semester.* Dr. ADAMS.

13. EXPERIMENTAL EMBRYOLOGY AND REGENERATION.—An analysis of the factors concerned in individual development. Lectures and demonstrations. *Twice a week; first semester.*

Associate Professor ZELENY.

13a. EXPERIMENTAL EMBRYOLOGY AND REGENERATION.—(Laboratory.) The application of the experimental method to a definite problem in embryology or regeneration. The work will be individual. *Two to five times a week; both semesters.*

Associate Professor ZELENY.

15. VARIATION AND HEREDITY.—An analysis of the fact of variation and heredity with reference (a) to the factors of organic evolution and (b) to the principles of animal breeding. Lectures and demonstrations. *Twice a week; second semester.*

Associate Professor ZELENY.

15a. VARIATION AND HEREDITY.—(Laboratory.) The application of the experimental method to a difinite problem in variation or heredity. The work will be individual. *Two to five times a week; both semesters.*

Associate Professor ZELENY.

17. FIELD ZOOLOGY.—The work is planned to give as comprehensive a knowledge as practicable of the animal life

of a restricted locality. Collection, preservation and identification of various kinds of animals, together with observations of the habits and life histories of selected forms, constitute the major part of the work. *Four times a week; first semester.* Associate Professor SMITH.

18. ADVANCED FIELD ZOOLOGY.—A continuation of course 17 providing an opportunity for intensive work on more restricted problems in connection with the local fauna. A taxonomic or distributional problem is studied and the work may be made introductory to subsequent investigation in this field. *Three to five times a week; both semesters.*

Associate Professor SMITH.

20. CURRENT LITERATURE.—The instructors and advanced students of the department meet as a journal club for the presentation and discussion of the results of recent zoological investigation. All students doing major work in zoology are expected to take active part. *Once a week; both semesters.* Associate Professor ZELENY.

21. INTRODUCTION TO ZOOLOGICAL RESEARCH.—Students looking forward to independent investigation will be assigned definite topics, usually repeating the work of earlier investigators and will be directed in working out the morphology, life history, or reciprocal relations of invertebrate forms. Laboratory work with stated conferences and assigned reading. *Two to five times a week; both semesters.*

Professor WARD.

22. MORPHOLOGY OF VERTEBRATES.—Lectures and laboratory work on the different classes of Vertebrates, including careful dissection of a series of types, a comparative study of the skeleton and detailed studies of brain, cranial nerves, and the eye and ear. *Both semesters; two lectures and four hours laboratory work a week.* Professor KINGSLEY.

29. ADVANCED ANIMAL ECOLOGY.—A study of special problems in ecology, distribution and faunas, with reference to the interpretations of the relation between animals and their environments. Conferences, laboratory and field work. *Two to five times a week; both semesters.* DR. ADAMS.

E. Engineering

The degree of Doctor of Philosophy in Engineering is offered in certain lines of academic graduate work of a high

scholastic type in engineering science that will attract students who wish to prepare themselves as teachers, investigators and experts.

The general requirements for this degree, as to preliminary education, linguistic attainments, etc., are the same as in other lines.

The following lines of engineering science are open as majors for the present:

Engineering mechanics
Hydraulic and sanitary engineering
Steam engineering
Electrical engineering
Heating and ventilation engineering
Railway engineering
Masonry and structural engineering

The first minor must be one of the following fundamental sciences or an authorized combination of two of them:

Theoretical mechanics
Mathematics
Thermodynamics
Chemistry
Physics (Experimental or mathematical)
Zoölogy
Botany

The second minor should be in other than engineering subjects.

ARCHITECTURE

Registration in graduate courses in architecture presupposes full undergraduate work in the subject or group of subjects chosen.

Courses for Graduates

101. Architectural Construction.—Design of special structures. *Two to six times a week; both semesters.*

Professors Ricker and White.

102. Sanitation of Buildings.—The planning of sanitation, warming, and ventilation for buildings of importance. *Two or three times a week; first or second semester.*

103. Advanced Architectural Graphics.—Advanced work in graphic statics, stereotomy, perspective, water color, and freehand drawing. *Two or three times a week; first or*

second semester. Professors MANN, RICKER and WELLS.

104. ARCHITECTURAL DESIGN.—Advanced architectural design. *Six times a week; first or second semester.*

Professor MANN.

105. ARCHITECTURAL PRACTICE.—Contracts, specifications, and office methods. A study of architectural jurisprudence. *Two or three times a week; first or second semester.*

Professor MANN.

106. ARCHITECTURAL HISTORY.—Research on special topics, such as: Sources and evolution of architectural forms; origin, development and geographical distribution of architectural styles; effects of function on architectural forms; bibliographical and chronological research. *Two to six times a week; first or second semester.*

Professors MANN and RICKER.

CIVIL ENGINEERING

Registration in graduate courses in Civil Engineering presupposes full undergraduate work in the subject or group of subjects chosen.

Courses for Graduates

106. REINFORCED CONCRETE DESIGN.—A study of specifications for reinforced-concrete design in the light of modern tests. The design of concrete forms. The design of typical reinforced-concrete structures. Methods and costs of reinforced-concrete construction. *Three times a week; both semesters.* Assistant Professor MCDANIEL.

107. BRIDGE ENGINEERING.—Theorems of Castigliano; Maxwell's reciprocal theorem; virtual velocities; deflections; camber; redundant members; special graphic methods; secondary systems; impact; general flexure; specifications; tension members; compression members; details of construction; manufacturing methods and costs; bridge erection. *Three times a week; both semesters.*

124. STEEL BUILDING CONSTRUCTION.—The design of steel framing of fireproof office buildings, hotels, and industrial buildings; design of steel buildings for industrial purposes; theory of wind bracing; long columns; eccentrically loaded columns; eccentric connections; spandrel bracing; details; braced bents; erection methods and costs. *Three times a week; both semesters.*

ELECTRICAL ENGINEERING

Registration in graduate courses in electrical engineering presupposes full undergraduate work in the subject or group of subjects chosen.

Courses for Graduates

101. ADVANCED COURSE IN ALTERNATING CURRENTS.—A study of polyphase circuits, alternating current machinery, alternating current measuring apparatus, or a combination of these subjects. *Twice a week; both semesters.*

Professor BROOKS.

103. ELECTRICAL DESIGN.— The development of plans for an electrical machine or apparatus of special character, or for the arrangement of an electrical plant, or for the installation of such machinery or apparatus. *Twics a week; second semester.* Assistant Professor WALDO.

104. TELEGRAPHY AND TELEPHONY.—*Twice a week; second semester.* Professor BROOKS, Assistant Professor PAINE.

105. ELECTRICAL ENGINEERING RESEARCH.—An experimental investigation of some electrical phenomena, or tests of some electrical machine, or of a plant of such machines. *Twice a week; both semesters.*

Assistant Professor BRYANT.

106. ILLUMINATION.—*Once a week; both semesters.*

Professor BROOKS, Assistant Professor BRYANT.

Courses for Graduates and Advanced Undergraduates

14. ALTERNATING CURRENTS.—*Four times a week; first semester.*

Professor BERG, Assistant Professors PAINE and BRYANT.

17. ADVANCED ALTERNATING CURRENTS.—*Four times a week; second semester.*

Professor BERG, Assistant Professors PAINE and BRYANT.

27. ELECTRICAL ENGINEERING LABORATORY.—*Twice a week; second semester.* Assistant Professor BRYANT.

MECHANICAL ENGINEERING

Registration in graduate courses in mechanical engineering presupposes full undergraduate work in the subject or group of subjects chosen.

Courses for Graduates

106. HEAT MOTORS.—The advanced theory of the internal combustion motor, and of the steam turbine; the general principles and methods of refrigeration. *Twice a week; second semester. One unit.* Professor GOODENOUGH.

107. THERMODYNAMICS.—The general principles of thermodynamics and their application to the solution of engineering problems. *Twice a week; first semester. One unit.* Professor GOODENOUGH.

109. MACHINE DESIGN.—The general principles of rational design; the application of mechanics of materials. Individual problems. *Twice a week; either semester. One unit.* Professor LEUTWILER.

112. LABORATORY INVESTIGATIONS.—Special investigations of problems relating to the combustion of fuels; boiler economy; steam engines and turbines; gas engines and producers; properties of explosion mixtures; mechanical refrigeration. Original work. *Three times a week; both semesters. One and one-half units.* Professor RICHARDS.

114. DYNAMICS OF MACHINERY.—Advanced problems; whirling and vibration of shafts; theory of governors; fly wheels; force and mass reduction; stresses in rotating masses. *Twice a week; both semesters. One unit.* Professor GOODENOUGH.

Courses for Graduates and Advanced Undergraduates

The following are acceptable as minor courses for students who are not candidates for advanced degrees in mechanical engineering:

6. HEAT ENGINES. The steam engine; steam turbine; gas engine; air compressor; refrigerating machine. Mixture of gases; combustion of gaseous fuels. (A continuation of course 7.) *Twice a week; both semesters.* Professor RICHARDS and Professor GOODENOUGH.

7. THERMODYNAMICS.—The transformation of heat into work; the second law and its connection with irreversible processes, the properties of heat media, the perfect gases, saturated and superheated vapors; the flow of fluids. *Three times a week; second semester.* Professor GOODENOUGH.

8. MECHANICS OF MACHINERY.—Friction in machine parts;

useful application of friction as in friction clutches and brakes; transmission of power by ropes and belting; brakes, clutches and dynamometers; hoisting machinery; hoisting in mines; elevators and cranes; hydraulic machinery; accumulators, and centrifugal pumps; fans, blowers, air compressors, air motors and transmission of power by means of air. *Three times a week; first semester.*

Assistant Professor LEUTWILER.

9. MACHINE DESIGN.—Theory of machine design, with applications; investigation of actual machines similar to the one to be designed; design of machinery subjected to heavy and variable stresses; punches, shears, presses, riveters, and cranes. *Three times a week; both semesters.*

Assistant Professor LEUTWILER.

12. MECHANICAL ENGINEERING LABORATORY.—Experiments on engines, turbines, gas engines, pumps, boilers, injectors, air compressors, hoisting appliances, heating apparatus, and refrigerating machines. Tests of power plants in the vicinity. *Three times a week; first semester.*

MECHANICS, THEORETICAL AND APPLIED

Registration in graduate courses in theoretical and applied mechanics presupposes full undergraduate work in the subject or group of subjects chosen.

Courses for Graduates

101. ANALYTICAL MECHANICS.—The fundamental premises of mechanics; methods of treatment and attack; the more complex problems and applications; a critical and comparative study of texts. *Twice a week; first semester. One unit.*

Assistant Professor MOORE.

102. RESISTANCE OF MATERIALS.—Advanced work on the properties of materials used in engineering construction and the methods of determining these properties; analysis and investigation in mechanics of materials, including the effect of form of member in a structure or machine and the method of application of forces. Comparative study of texts may be made. *Twice a week; second semester. One unit.*

Assistant Professor MOORE

103. HYDRAULICS AND HYDRAULIC ENGINEERING.—The laws

of hydraulics and their application to engineering problems; hydraulic power and its development; design and investigation. *Twice a week; second semester. One unit.*

Professor TALBOT, Assistant Professor MOORE.

104. EXPERIMENTAL WORK IN LABORATORY OF APPLIED MECHANICS.—(a) Laboratory investigation in the materials testing laboratory on materials and on their action as used in machines and structures; (b) experimental work in hydraulic laboratory with pumps, motors, and measuring devices, and the investigation of the laws of hydraulics, the development of power, and the study of various hydraulic problems. *Twice a week; both semesters. One half to two units.*

Professor TALBOT, Assistant Professor MOORE.

105. EXPERIMENTAL AND ANALYTICAL WORK IN REINFORCED CONCRETE.—Research work in reinforced concrete. The interpretation of available experimental results and their application to the design of structure. The principles of construction and a study of typical reinforced concrete structures. *Twice a week; both semesters. One and one half units or more.* Professor TALBOT.

MINING ENGINEERING

Registration in graduate courses in mining engineering presupposes full graduate work in the subject or group of subjects chosen.

The laboratory connected with the extended investigation of mining conditions in Illinois now being carried on by the Department of Mining Engineering, the State Geological Survey and the United States Bureau of Mines, together with the Mine Rescue Station operated by the same parties, are available for graduate instruction in addition to the regular University laboratories.

Courses for Graduates

101. ADVANCED MINING METHODS.—Including a study of the coal and ore fields of the United States, methods of mining the same, and the economics of mining, including the utilization, marketing, storage and transportation of coal and ores. *Twice a week; both semesters. One unit.*

Professor STOEK.

102. ADVANCED PREPARATION OF COAL AND ORES.—*Twice*

a week; both semesters. One unit. Dr. Lincoln.

Courses for Graduates and Advanced Undergraduates.

5. Mine Ventilation and Mine Gases. Professor Stoek.
6. Mechanical Engineering of Mines.
9. Preparation of Coal and Ores. Dr. Lincoln.

MUNICIPAL AND SANITARY ENGINEERING

Entrance upon graduate work in municipal and sanitary engineering presupposes a full undergraduate course in that subject.

Courses for Graduates

102. Water Supply Engineering.—Advanced work in water supply engineering will be arranged to fit the conditions of individual classes. Sources and requirements of water supply, general water works construction, pumps and pumping, design of reservoirs and elevated tanks, and water works operation and the valuation of plants are among the topics which may be treated. *One to three times a week; first or second semester. One unit.* Professor Talbot.

103. Sewerage.—General sewerage design and construction, a study of sewerage systems, hydraulics of sewers, and a study of run-off, are examples of the work which may be taken up. *Once or twice a week; second semester. One unit.* Professor Talbot.

106. Water Purification, Sewage Disposal and General Sanitation.—The design, construction, and operation of water purification plants and of sewage disposal works, the study of existing plants, comparison of results and cost of construction and operation may be taken up in this course. Experimental work on water filters, septic tanks, etc., may be included. Garbage disposal and general sanitation may also be taken. *Once a week; second semester. One-half unit.* Professor Talbot.

RAILWAY ENGINEERING

Registration in graduate courses in railway engineering presupposes full undergraduate work in the subject or group of subjects chosen.

The equipment of the department of railway engineering includes a modern laboratory for testing locomotives, a dynamometer car designed for train resistance and locomotive

tests on steam roads, and an electric test-car for similar work on electric lines. The department owns also a drop testing machine and a brakeshoe testing machine, which conform, in their design, to the standards of the Master Car Builders' Association.

Courses for Graduates

102. LOCOMOTIVE DESIGN.—Study and analysis of modern practice concerning steam pressure, compounding, superheating, etc. The work in this course may be arranged to suit special requirements of the individual student. *Once a week; both semesters. One unit.* Professor GOSS.

106. LOCOMOTIVE OPERATION.—Study and determination of train resistance and locomotive tractive effort. The application of these and other matters in the establishment of tonnage ratings. *Once a week; both semesters. One unit.* Professor SCHMIDT.

108. ELECTRIC RAILWAYS.—This course deals with the design, selection, and operation of electric railway equipment. Central station, sub-station, rolling stock, and line equipment are considered. The emphasis is put upon either design or operation according to the training and purpose of the student. *Once a week; both semesters. One unit.* Assistant Professor BUCK.

110. RAILWAY LOCATION.—This course is essentially a study of the effects of the location of a railway upon its earning capacity. It deals with the engineering and economic problems met with in original location, as well as in the relocation and reduction of grades of existing lines. *Once a week; both semesters. One unit.* Mr. COMSTOCK.

Courses for Graduates and Advanced Undergraduates

4. LOCOMOTIVE PERFORMANCE. *Twice a week; first semester.* Professor SCHMIDT.

33. ECONOMIC THEORY OF RAILWAY LOCATION.—*Four times a week; first semester.* Mr. COMSTOCK.

64. ELECTRIC RAILWAY PRACTICE.—*Three times a week; first semester.* Assistant Professor BUCK.

65. ELECTRIC RAILWAY PRACTICE.—*Three times a week; second semester.* Assistant Professor BUCK.

F. Agriculture

AGRONOMY

Students who wish to do their major work in agronomy must have had the major courses offered in that subject to undergraduates in the college of agriculture of the University of Illinois, or the equivalent. While every one seeking a doctor's degree with agronomy as a major will be required to have a good knowledge of the whole field of agronomy, each student is expected to be especially prepared in some of the following divisions of the field: Soil fertility, plant breeding, soil physics, crop production and soil biology.

Students who are taking their major work in other departments and choose agronomy as a minor, must have had previously the work in chemistry, botany and other fundamental sciences prescribed for the undergraduate courses in agronomy in the College of Agriculture, or the equivalent.

Courses for Graduates

101. Soil Investigation.—A study of systems of soil investigation; sources of error and methods of control; interpretation of results. *Once a week; second semester.*
Professor Hopkins.

103. Soil History.—Different systems of agricultural practice and their ultimate effect upon the soil. *Once a week; second semester.* Professor Hopkins.

112. Plant Breeding.—This course includes a detailed study of the experiments at this station, and of methods and results reported from other states and from foreign countries. *Twice a week; both semesters.* Professor Smith.

118. Investigation.—A special problem is chosen and worked out under the advice and direction of the instructor. *One to five times a week; both semesters.*
Professors Hopkins, Smith, Mosier, Pettit.

Courses for Graduates and Advanced Undergraduates

9. Soil Physics and Management.—Origin of soil material; methods of formation; mechanical composition and classification; moisture; texture as affecting capillarity, osmosis, diffusion, temperature, aeration, etc. *Five times a week; first semester.* Professor Mosier, Mr. Gustafson.

11. Soil Biology.—Activities of infusoria, fungi, algæ, and bacteria in soils from the standpoint of soil fertility; fermentation of crop residues and green and farm manures and its effect upon insoluble plant food; fixation of atmospheric nitrogen, its transformations, use, and possible losses. *Three times a week; second semester.* Professor Pettit.

12. Soil Fertility, Fertilizers, Rotation.—The influence of fertility, natural or supplied, upon the yield of various crops; effect of different crops upon the soil and upon succeeding crops, etc. *Five times a week; second semester.* Professor Hopkins, Mr. Fisher.

16. German Agricultural Readings.—The current numbers of German journals on agricultural science are required as a text. *Twice a week; second semester.* Professor Hopkins.

22. Plant Breeding.—The improvement by breeding of field crops, including the grains, grasses, and legumes; the principles and methods of selection with critical studies of results obtained by various investigators. Lectures, assigned readings, demonstrations, and laboratory exercises. *Second semester.* Professor Smith.

23. Plant Food Supplies.—The world's supply of plant food materials, including methods of utilization. *Once a week; second semester.* Professor Pettit.

24. Mechanical Composition of Soils.—A study of the mechanical composition of the soil and its influence upon granulation, absorption and retention of moisture, and other physical properties affecting crop production. *Arrange time; first semester.* Professor Mosier.

ANIMAL HUSBANDRY

Students entering graduate work in animal husbandry must have had a thorough training in the fundamental principles of the subject either in connection with or in addition to an agricultural course of study substantially equivalent to that offered in this University.

Courses for Graduates

103. Live Stock Experimentation.—Objects, methods and the sources of error in experimental work dealing with the feeding, breeding and management of farm animals.

Critical study of live stock experiments at this and other experiment stations. *Once a week; both semesters. One-half to one and one-half units.* Professor MUMFORD.

110. ANIMAL NUTRITION.—The course includes a thorough study of the chemical and physiological changes and processes involved in the activities of animal life. *Three times a week; both semesters. One unit.*

Professor GRINDLEY, Dr. JOSEPH.

111. ANIMAL NUTRITION.—A study of methods employed in the examination and analysis of feeding stuffs; also animal substances including flesh, fat, bone, urine, feces, and manufactured animal products. *Three to five times a week; both semesters. One to two units.* Professor GRINDLEY.

112. INVESTIGATION.—Opportunity is afforded to pursue investigations along the following lines:

(a) Economic Factors Involved in the Various Phases of Meat Production.

(b) Systems of Live Stock Farming.

(c) The Valuation of Pedigrees a, b and c. *Once a week; both semesters. One to two units.* Professor MUMFORD.

(d) Animal Nutrition. A research course in Animal Nutrition including digestion and metabolism experiments and biochemical studies connected with the nutrition of farm animals. *Five times a week; both semesters. One to two units.* Professor GRINDLEY, Dr. JOSEPH.

116. SEMINAR.—The subject of study for 1913-1914 will be the food requirements for the growth and fattening of farm animals. *Arrange time; both semesters. One-quarter unit.* Members of the Staff.

117. GENETICS.—A study and criticism of the more important genetic experiments, the biological and mathematical methods employed, and the validity of the conclusions. *Three to five times a week; both semesters. One to two units.*

Assistant Professor DETLEFSEN.

118. GENETICS.—A study and criticism of the more important genetic experiments, the biological and mathematical methods employed, and the validity of the conclusions. Lectures; conferences; assigned readings; laboratory problems. *Three to five times a week; first and second semesters. One-half to one and one-half units.*

Assistant Professor DETLEFSEN.

Courses for Graduates and Advanced Undergraduates

7. PRINCIPLES OF ANIMAL NUTRITION.—*Five times a week; first semester. One and one-half units.*

Professor GRINDLEY, Dr. JOSEPH.

2. ADVANCED STOCK JUDGING.—A study of animal conformation with reference to market and show yard form; quality and condition. *Five times a week; second semester.*

Various members of the department.

24. MEAT.—A study of the influence of type, condition, age, sex and feeds upon the yield and market grade of meat products. *Once a week; second semester.*

Assistant Professor HALL.

[Not given in 1913-14.]

25. WOOL.—A study of the factors affecting the quality, quantity, strength, and condition of wool. *Once a week; second semester.* Assistant Professor COFFEY.

26. SWINE.—The factors of Animal Nutrition that have to do with the large and economical production of pork and the determination of type in swine. *Once a week; second semester. One-half unit.* Mr. CARMICHAEL.

[Not given in 1913-14.]

27. SHEEP HUSBANDRY.—Dealing with the factors determining the importance of the industry in leading sheep growing countries and particularly in different parts of the United States. *Arrange time; second semester.*

Assistant Professor COFFEY.

30. GENETICS.—The fundamental principles of heredity and variation. *Daily; second semester.*

Assistant Professor DETLEFSEN.

31. PRINCIPLES OF ANIMAL NUTRITION.—Continuation of 7. *Three to five times a week; both semesters.*

Professor GRINDLEY, Dr. JOSEPH.

32. MARKETING LIVE STOCK.—A study of marketing and methods of marketing live stock and their products. *Twice a week; secand semester.* Professor MUMFORD.

DAIRY HUSBANDRY

Students entering graduate work in Dairy Husbandry must have had a thorough training in the fundamental principles of the subject of their major or minor, substantially equivalent to that offered in this University.

Courses for Graduates

101. Economic Milk Production.—A study of differences in the efficiency of dairy cows, cause and effect of the same, and the relation they bear to successful dairy farming. *Twice a week; both semesters. One unit.*

Professor Fraser.

102. Research.—A study of the investigations in progress in the dairy herds of the State. *Both semesters. One unit.* Professor Fraser.

103. Research.—Dairy Feeding problems. *Both semesters. One unit.* Professor Fraser.

Courses for Graduates and Advanced Undergraduates

7. Butter Making and Factory Management.—Cream receiving and ripening; pasteurization; use of commercial starters; churning; salting; working and marketing butter; butter scoring; separators; special problems for the manufacture of butter; private and co-operative management of creameries; centralizers' systems; creamery accounting and business methods; refrigerating; ice cream making; location and planning of creamery buildings. Lectures, assigned readings, and laboratory practice. *Second semester; six times per week.* N. W. Hepburno, Mr. Lang.

11. Dairy Bacteriology.—The relation of bacteria to the dairy industry; changes commonly effected in milk by bacteria; market milk; inspected milk; certified milk; pasteurized milk; bacteria characteristic of different groups; bacteria producing milk of unusual character; preserved milks; butter; oleomargarine; cheese. *Three times a week; second semester.* Mr. Parker.

21. Economic Milk Production.—*Five times a week; second semester.* Professor Fraser, Mr. Brand.

HORTICULTURE

At least two years of collegiate work in horticulture and allied subjects and the requisite preparation for the chosen topics are required for entrance upon major work in this department.

*On leave.

Courses for Graduates

102. POMOLOGY.—Special problems in the adaption, propagation, cultivation, or pruning of small fruits.

Professor CRANDALL.

103. OLERICULTURE.—Special problems in the structure, cultural requirements, and improvement of vegetables.

Professor LLOYD.

108. POMOLOGY.—Special problems in the relationship, adaption, improvement, propagation, cultivation, pruning, protection, preservation, or marketing of orchard fruits.

Professor BLAIR, Professor CRANDALL.

109. FORESTRY.—Problems in general forestry and investigation of forest growths.

115. FLORICULTURE.—The horticultural status of various flowering plants, or special problems in the culture of greenhouse plants. Assistant Professor DORNER.

Courses for Graduates and Advanced Undergraduates

8. ORCHARDING.—A comprehensive study of pomaceous fruits (apple, pear, quince) and drupoceous or stone fruits (plum, cherry, peach, nectarine, apricot). *Five times a week; second semester.* Professor CRANDALL.

12. EVOLUTION OF HORTICULTURAL PLANTS.—History, botanical classification, and geographical distribution of cultivated plants; modification under culture; theoretical causes and observed factors that influence variation, particularly food supply, climate and cross-fertilization. *Five times a week; second half of first semester.* Professor CRANDALL.

18. EXPERIMENTAL HORTICULTURE.—Methods and difficulties in horticultural investigations; the planning of experiments; recording and interpretation of results. (For advanced students preparing for experiment station work.) *Five times a week; second semester.*

Professors BLAIR, LLOYD, CRANDALL.

ANNOUNCEMENT

OF

RESEARCH FELLOWSHIPS

IN THE

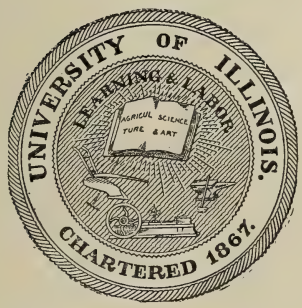
COLLEGE OF ENGINEERING

AND

CIRCULAR OF INFORMATION

OF THE

ENGINEERING EXPERIMENT STATION



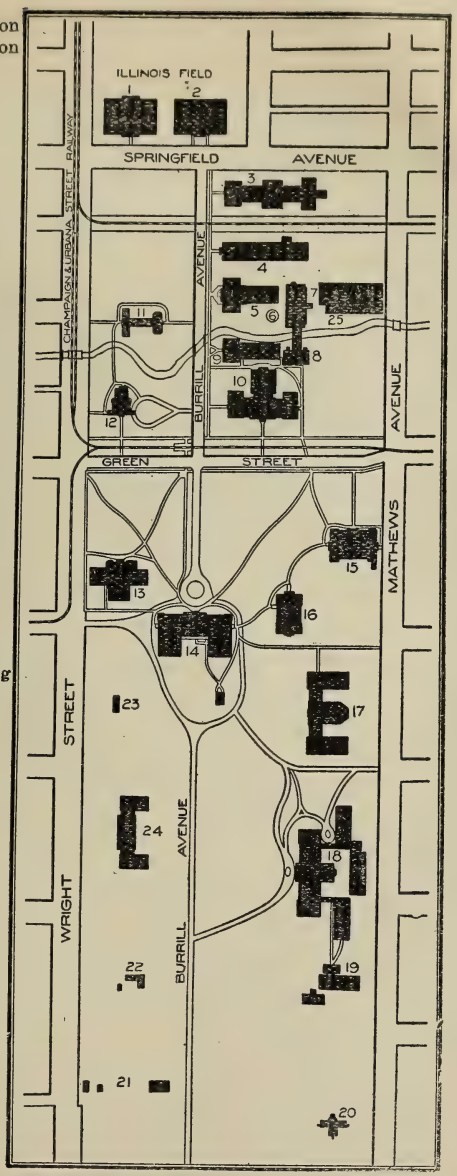
UNIVERSITY OF ILLINOIS

Diagram showing location of the principal buildings on the campus.

1. Men's Gymnasium
2. Armory
3. Wood Shops
4. Metal Shops
5. Electrical Laboratory
6. Reservoir
7. Heating Plant
8. Pumping Plant
9. Testing Laboratory
10. Engineering Building
11. Greenhouse
12. President's House
13. Library Building
14. University Hall
15. Natural History Hall
16. Law Building
17. Chemistry Building
18. Agricultural Buildings
19. Horticulture Building
20. Observatory
21. Warehouse
22. Veterinary Building
23. Insectary
24. Woman's Building
25. Mechanical Engineering Laboratory

Not shown here:

Agronomy Building
Beef Cattle Building
New Insectary
Ceramics Laboratory
Farm Mechanics Building



UNIVERSITY GROUNDS AND BUILDINGS

THE UNIVERSITY CALENDAR

1907-1908

First Semester

1907

Sept. 11, Wednesday, 8 a. m.	Entrance Examinations begin.
Sept. 16, 17, Monday and Tuesday.	Registration Days.
Sept. 18, Wednesday, 8 a. m.	Instruction begins.
Nov. 27, Wednesday, 5 p. m.	Thanksgiving Recess begins.
Dec. 1, Monday, 8 a. m.	Instruction begins.
Dec. 21, Saturday, 5 p. m.	Holiday Recess begins.
1908	
Jan. 3, Friday, 8 a. m.	Instruction begins.
Jan. 30, Thursday, 5 p. m.	First Semester ends.

Second Semester

Feb. 3, Monday, 8 a. m.	Instruction begins.
April 16, Thursday, 5 p. m.	Easter Recess begins.
April 21, Tuesday, 8 a. m.	Instruction begins.
June 10, Wednesday	Thirty-seventh Annual Commencement.

Summer Session

1907	
June 17, Monday.	Instruction begins.
August 16, Friday.	Session ends.

ENGINEERING EXPERIMENT STATION

STAFF

EDMUND JANES JAMES, Ph. D., LL. D., President.

JAMES McLAREN WHITE, B. S., Dean of the College of Engineering.

LESTER PAIGE BRECKENRIDGE, Ph. B., Director of the Engineering Experiment Station.

NATHAN CLIFFORD RICKER, D. Arch., Professor of Architecture.

IRA OSBORN BAKER, C. E., D. Eng., Professor of Civil Engineering.

ARTHUR NEWELL TALBOT, C. E., Professor of Municipal and Sanitary Engineering and in Charge of Theoretical and Applied Mechanics.

LESTER PAIGE BRECKENRIDGE, Ph. B., Professor of Mechanical Engineering.

ALBERT PRUDEN CARMAN, Sc. D., Professor of Physics.

MORGAN BROOKS, Ph. B., M. E., Professor of Electrical Engineering.

JAMES McLAREN WHITE, B. S., Professor of Architectural Engineering.

EDWARD CHARLES SCHMIDT, M. E., Associate Professor of Railway Engineering.

ROY WEAVER RUTT, B. S., Assistant to the Director.

SPECIAL INVESTIGATORS

HENRY BERNHARD DIRKS, M. E., Assistant in Mechanical Engineering.

DUFF ANDREW ABRAMS, B. S., Assistant in Laboratory of Applied Mechanics.

FRANK KEEHN OVITZ, B. S., Assistant in Chemistry.

CHARLES SAMUEL McGOVNEY, B. S., Assistant in Charge of Fuel Tests.

ROY DELOS KUNKLE, B. S. Draftsman.

THOMAS HAMER AMRINE, B. S., Assistant in Electrical Engineering.

WARD REID ROBINSON, B. S., Assistant in Laboratory of Applied Mechanics.

SAMUEL WALKER SHATTUCK, C. E., Comptroller of the University.

WILLIAM LOW PILLSBURY, A. M., Registrar of the University.

ANNOUNCEMENT OF RESEARCH FELLOWSHIPS IN THE COLLEGE OF ENGINEERING

On January 22, 1907, the Board of Trustees of the University of Illinois voted that the Engineering Experiment Station be authorized to offer ten Research Fellowships in the College of Engineering, of an annual value of $500.

It is the purpose of this circular to give information concerning these fellowships and to describe the facilities for experimental work now available in the College of Engineering.

Until the present year the University of Illinois has offered but eight fellowships, each at an annual stipend of $300. These fellowships have been distributed among the different colleges of the University. Experience has shown that in the College of Engineering especially it is difficult to persuade desirable men to remain for their graduate work at that amount, as active engineering practice offers tempting pecuniary inducements to them upon graduation. Engineering graduate work, therefore, has usually been done *in absentia* requiring three years, often four or five, to obtain the master's degree, a certain amount of the actual engineering experience usually being accepted in lieu of certain prescribed courses.

Since the organization of the Engineering Experiment Station in 1903 opportunities for doing graduate work of high grade have developed rapidly in connection with the research work and experimental investigations there carried on. The facilities now available for such work offer exceptional advantages to superior investigators desiring to pursue graduate work.

In recognition of these conditions, the Board of Trustees has deemed it wise and just to establish ten Research Fellowships in the College of Engineering at a stipend of five hundred dollars a year. In order that these research fellowships shall not interfere with those in the other departments of the University it has seemed best that men accepting them should remain two years in order to obtain their second degree. They are thus placed about midway between the usual University fellowship which requires one year's residence and the men engaged in practical work who are pursuing their graduate studies *in absentia* for the required three years. It is expected that men accepting these fellowships shall devote a certain amount of time to regularly assigned work in the Station, aside from their graduate studies. These assignments will be along the lines of investigation already laid out by the Station, and may easily coincide with the major subjects chosen for the graduate work. This amount of time may vary according to individual cases, but will not exceed one-half of the entire time, each year. At the date of registration an equitable distribution of time will be made between the work of the Station and that pursued purely for the graduate degree. It is probable that a considerable amount of the work done for the Station will count directly towards the degree.

The Station will distinctly discourage applications from men who are attracted merely by a $500 fellowship and the prospect of securing their master's degree, and in making the assignments, preference may be given to men who have had some experience or training beyond their bachelor's degree. The Station wishes to encourage students who are imbued with the true spirit of research and whose chosen line of graduate work will be along the lines of important investigations which the Station desires to pursue. In this way it is hoped to secure a picked body of experts some of whom may be attached later to the regular corps of station investigators. By throwing open these fellowships to graduates of both American and foreign universities, it is thought that many advantages will be derived from the combination of the various methods of training and that valuable results will accrue to the Station.

It may be well to emphasize here the advantages for experimental work offered in our laboratories to those who expect to become teachers of engineering subjects.

Fellowships

On January 22, 1907, the Board of Trustees of the University of Illinois voted that there should be established in the Engineering Experiment Station of the College of Engineering ten Research Fellowships, each with a stipend of five hundred dollars a year, payable in ten monthly installments, with exemption from incidental and tuition fees.

The regulations governing appointments to these fellowships are as follows:

1. The purpose of these fellowships is to promote advanced scholarship and original research in the College of Engineering.

2. These fellowships are open to graduates of approved technical schools and universities, both American and foreign.

3. Nominations to fellowships, accompanied by assignments to special departments of the Engineering Experiment Station are made upon applications received by the Engineering Experiment Station each year not later than the first day of February. These nominations are made within the month of February by the Station Staff, subject to the approval of the Faculty of the Graduate School and the President of the University. Appointments are made in March, and take effect the first day of the following September. *Vacancies may be filled by similar nominations and appointments at other times.*

4. Nominations to fellowships are made upon the grounds of worthiness of character, scholastic attainments, and promise of success in the principal line of study or research to which the candidate proposes to devote himself.

5. Applications for these fellowships shall be made for two consecutive collegiate years.

6. Candidates must present with their applications full information concerning themselves and their qualifications for advanced study and research work, including any written or published papers or results of investigation, and must name the subjects in which they wish to do their major work. Candidates should also present a statement from the faculty of the college of which they are graduates, certifying that they are well qualified for research work and experimental investigation, and that they give promise of doing valuable work along these lines.

7. Fellows are members of the Graduate School and have all of the privileges and bear all the responsibilities of such membership. Each regular fellow will be expected to devote a part of his time, not to exceed one-half, to regular assignment of work in the Engineering Experiment Station. These services will receive such credit as may be determined in each case.

Advanced Degrees

The advanced degrees conferred on engineering students by the University of Illinois are as follows:

Master of Architecture after Bachelor of Science in the courses of Architecture, Architectural Decoration and Architectural Engineering.

Civil Engineer after Bachelor of Science in the courses in Civil Engineering and Municipal and Sanitary Engineering.

Electrical Engineer after Bachelor of Science in the course in Electrical Engineering.

Mechanical Engineer after Bachelor of Science in the course in Mechanical Engineering.

Master of Science after Bachelor of Science in courses in the College of Science.

All candidates for second degrees are required to register in the Graduate School, to pursue an approved course of study for one academic year in residence, or, in the case of Engineering Experiment Station fellowships, for two academic years in residence; and to pass satisfactory examinations upon all the studies of the approved course.

Each candidate for a second degree must present an acceptable thesis in the line of his major subject of study. The subject of this thesis with the approval of the head of department must be announced to the Dean

of the Graduate School not later than the first Monday in November of the academic year in which the course is to be completed. The completed thesis, upon regulation paper, with the certified approval of the professor in charge, must be presented to the Dean of the Graduate School not later than June 1.

The degree of Doctor of Philosophy may be conferred upon any member of the Graduate School who shall have reached high attainments in scholarship, who shall have shown marked ability in some lines of literary or scientific investigation, and shall have presented a thesis giving clear indications of such scholarship and of such power of research. Candidates for the degree must also prove their ability to use French and German sufficiently for work in their lines of research. At least the first two, or the last one, of *three years* of graduate study must be in residence at this University.

The time and study required for a master's degree may be included in the years required, but approval of a course of study for a doctor's degree must be upon the condition that the candidate is prepared through his baccalaureate work, or otherwise, to enter upon his advanced work in the line of his major subject, and the work on this major subject must be continued through the three years.

For further information, application blanks, etc., address the Director of the Engineering Experiment Station, Urbana, Illinois.

THE UNIVERSITY AND ITS LOCATION

The University of Illinois is situated in Champaign County, in the east central part of the state, between the cities of Urbana and Champaign, and within the corporate limits of the former, the west edge of the University campus being the dividing line between the two cities. Urbana-Champaign is one hundred twenty-eight miles south of Chicago at the junction of the Illinois Central, the Cleveland, Cincinnati, Chicago and St. Louis, and the Wabash railroads. It is also about twenty-six hours distant by rail from New York and Philadelphia. The adjacent county is a rich and prosperous agricultural region. The cities of Champaign and Urbana together have a population of about 20,000.

The University of Illinois is one of the largest of the state universities which owe their origin to the Federal Land Grant of 1862. It was founded by an act of the State Legislature, and opened its doors to students March 2, 1868. The institution depends chiefly upon state appropriations for permanent improvements and maintenance and the State of Illinois has supported it most liberally. The present value of the property and assets is estimated at $2,800,000. In consequence of the congressional act of 1890, the University now receives

from the United States about $40,000 per annum including the Agricultural Experiment Station funds.

The University comprises the following colleges and schools, part of them located at Urbana and part of them in Chicago. Those at Urbana are:

THE GRADUATE SCHOOL.
THE COLLEGES OF LIBERAL ARTS, including the College of Literature and Arts and the College of Science.
THE COLLEGE OF ENGINEERING.
THE COLLEGE OF AGRICULTURE.
THE COLLEGE OF LAW.
THE SCHOOL OF LIBRARY SCIENCE.
THE SCHOOL OF MUSIC.
THE SCHOOL OF EDUCATION.
THE SCHOOL OF RAILWAY ENGINEERING AND ADMINISTRATION.

In connection with the College of Agriculture the Agricultural Experiment Station for Illinois is maintained at Urbana, partly by state and partly by federal appropriations.

The Engineering Experiment Station, established by the Board of Trustees in 1903, is at Urbana, in connection with the College of Engineering.

The offices of the State Laboratory of Natural History, State Entomologist, State Water Survey, and State Geological Survey are located at Urbana.

The departments of the University located in Chicago are:

THE COLLEGE OF MEDICINE.
THE SCHOOL OF PHARMACY.
THE COLLEGE OF DENTISTRY.

Courses Offered in the College of Engineering

The following courses are offered in the College of Engineering:

ARCHITECTURE.
ARCHITECTURAL DECORATION.
ARCHITECTURAL ENGINEERING.
CIVIL ENGINEERING.
ELECTRICAL ENGINEERING.
MECHANICAL ENGINEERING.
MUNICIPAL AND SANITARY ENGINEERING.
PHYSICS.
RAILWAY CIVIL ENGINEERING.
RAILWAY ELECTRICAL ENGINEERING.
RAILWAY MECHANICAL ENGINEERING.
RAILWAY ADMINISTRATION. (Offered by the Department of Economics in the College of Literature and Arts).

ENGINEERING EXPERIMENT STATION

The Engineering Experiment Station of the University of Illinois was established in 1903 in connection with the College of Engineering. It is the purpose of the Station to carry on investigations along various lines of engineering, and to make studies of problems of importance to professional engineers, and to the manufacturing, mining, railway, constructional and industrial interests of the state. It is believed that this experimental work will result in contributions of value to engineering science and to the industries of the state, and that the pursuit of such investigations will give inspiration to students and add to the value of the instructional work in the College of Engineering. The value to the different states in the Union of the work done by the agricultural experiment stations has suggested the possibility of doing work of similar value to the industrial interests.

Organization

The organization for directing the operations of the Station consists of a staff of eight members, representing with the director the heads of the different departments of the College of Engineering. The work of the College and the Station is thus very closely related.

The investigations are carried on by the members of the Staff directly, by Fellows as graduate work, by members of the instructional force of the College, and by special investigators belonging to the Station corps. Encouragement and aid will be given to instructors already employed by the University who desire to take up some line of research work.

Work Already Accomplished

The first work undertaken by the Engineering Experiment Station was an investigation of reinforced concrete and the properties of concrete affecting reinforced concrete construction. Considerable work has been done, making it one of the most extensive and systematic investigations on reinforced concrete made in this country. The work of the present college year on beams, T-beams, hooped columns, culvert pipe, etc., is expected to give valuable data on this type of construction. Various tests on timber and iron and steel have also been made.

The importance to Illinois manufacturing interests of information concerning the use of high-speed tool steels led the Station to make investigations in this field. The drainage of earth roads was also a very natural subject to present to the people of this state. The resistance of tubes to collapse has been made the subject of most careful investigation by the department of Physics. The extensive coal interests of the state coupled with the rapid growth of its manufacturing interests has suggested the extensive research work of the fuel tests of Illinois coals which are in progress. There is evident necessity for investigations relating to track construction and timely experiments have been made on the holding power of railroad spikes. Much

of the above work will be continued, but several new fields of investigation will be entered in the near future. A list of all bulletins published to date will be found on the last page.

Facilities and Equipment

The rapid growth in attendance in the College of Engineering has made it necessary to extend its equipment considerably, and while the apparatus thus provided is intended primarily for purposes of instruction, much of it is available at certain times of the year for purposes of investigation. Many appliances have recently been purchased and installed for the especial use of various departments in connection with such investigations as are in progress in these departments. In addition to appliances purchased for purely instructional purposes considerable money has been expended for those special researches that are in progress in the Engineering Experiment Station itself. When an investigation has been concluded the equipment becomes a part of the regular laboratory to which it most naturally belongs.

The Engineering Experiment Station is not quartered in any one building of the College of Engineering, but its work and experiments go on wherever the needed facilities exist in the various departments. Neither is its work confined to the College of Engineering alone. Cooperation with other University departments, such as the College of Science, State Water Survey and with the State Geological Survey enables it to complete many investigations, facilities for which are not available within the College of Engineering. Neither is its work confined within the limits of the University. Cooperation with various departments of the federal gov-

ernment as well as with many industrial interests of the state is already assured. In this circular it is possible to enumerate only a few of the most important appliances available for use in the various lines of research.

The various laboratories of the College of Engineering, viz., Cement, Electrical, Hydraulic, Materials-Testing, Mechanical, Physics, Railway, and Road-Materials, are well-equipped in their several departments for carrying on investigations of many kinds. Bulletin No. 3 describes this equipment in full.

All of the laboratories are supplied with small instruments, such as scales, gages, thermometers, indicators, tachometers, counters, pyrometers, meters, electrical measuring devices, etc., necessary in connection with their special work. The Station also owns a complete line of calculating machines. The department of Physics is prepared to standardize nearly all of the instruments used in the laboratories.

In the Mechanical Engineering Laboratory

1. A Heine water-tube boiler (210 H. P.) equipped for fuel tests; installed with a Green chain grate and Sturtevant induced draft fan economizer.

2. A Foster superheater independently fired and capable of superheating steam from a 150 H. P. boiler 300° above its temperature at 120 pounds pressure.

3. Several residence heating boilers for steam and hot water.

4. A York 10-ton refrigerating plant supplied with tanks and cans for ice production.

5. A liquid air plant with a capacity of about three quarts an hour. Norwalk four-stage compressor (3000 lbs.) with Hampson liquefier.

6. An Ingersoll-Rand two stage air compressor driven by compound steam cylinders.

7. An Otto suction gas producer (50 H. P.) installed with an Otto gas engine (10 in. x 19 in. cylinders).

8. Steam engines of various types, Corliss, high speed steam turbines, which may be run condensing or non-condensing or with superheated steam.

9. Internal combustion engines of various types.

10. Automobile testing platform and dynamometers.

11. A Whiting 10-ton electric crane with three motors of A. C. type.

12. A Golden machine for testing lubricating oils and bearing metals.

In the Electrical Engineering Laboratory

1. A Gould storage battery of 60 cells each of 240 ampere hours capacity.

2. Various types of variable speed motors, two stationary armature alternators, three rotary convertors, transformers and complete instruments for testing.

3. Various types of arc and incandescent lamps and a laboratory for the study of illumination.

4. A special room for experiments in telegraphy and telephony.

In the Laboratory of Applied Mechanics

1. A Riehle vertical screw power testing machine of 600,000 pounds capacity. This machine will take tension and compression pieces 25 feet in length. The clear distance between screws is 36 inches. This machine is very accurate and sensitive.

2. An Olsen four-screw testing machine of 200,000 lb. for tests in tension, compression and flexure. This machine will take beams up to a length of 20 feet.

3. Three 100,000-lb. testing machines of different makes, fitted up in the usual way.

4. An Olsen torsion machine of 220,000 inch-pound capacity.

5. An Olsen vibratory testing machine for testing stay bolts.

6. A variety of smaller machines for testing cast iron, timber, etc.

7. A large equipment in measuring devices such as extensometers for various uses, autographic recording devices, gages, etc.

8. A compression machine of 800,000 lb. capacity for testing by external pressure large rings like 48-in. x 100-in. culvert pipe embedded in sand.

9. A commodious hydraulic laboratory, well equipped with steam engine, steam pumps, centrifugal pumps, standpipe and pressure tanks, lines of piping, measuring pits, tanks, weirs, gages, meters, motors, etc., giving excellent facilities for testing hydraulic apparatus and for making investigations in hydraulics.

10. Experimental water filters, of both slow sand and mechanical type.

11. Apparatus for testing resistance to flow of water through sand and screens.

12. Deep wells and pumps of the University pumping plant.

13. Opportunity to do experimental work on the septic tanks of the Champaign and Urbana sewerage systems.

In the Civil Engineering Laboratory

1. Equipment for testing road materials, such as two types of rattlers for testing brick; a Dorrey, a Deval and a Page machine for testing road building qualities for gravel and macadam.

2. A cement laboratory equipped with briquette molds, molding machines, testing machines, etc., necessary in testing hydraulic cement, and in making investigations as to the effect of different materials and methods of manipulation upon the strength of mortars and concrete.

In the Physics Laboratory

1. The checking and calibration of instruments for measuring temperatures.

The department has facilities for testing and checking thermometers and pyrometers. Standard thermometers of the best make, graded at 0.1° C. and certified by the Reichsanstalt, permit of tests between –25 C. and 250° C. Special constant temperature baths are available for the convenience and rapid comparison of thermometers.

The equipment for pyrometry is the best obtainable. The department owns a Callendar recorder of the laboratory type and a Whipple indicator with a series of platinum resistance thermometers ranging from 0° C. to 1200° C. In addition to these electric resistance pyrometers, a series of thermo-electric pyrometers is available for checking and testing other pyrometers. The thermo-electric couples with Reichsanstalt certificates are calibrated for temperatures from –180° C. to 1600° C.

The laws of relation of temperature, light and radiation, have within a few years been studied, so that it is now possible to measure temperatures by optical methods. The equipment in optical pyrometry consists of the Le Chatelier, the Wanner and Fery radiation pyrometers.

For the production of extreme temperatures, both low and high, the department is provided with a liquid-

air machine, and with electric furnaces of the arc and of the resistance types. A specially protected constant temperature room has been provided for work of all kinds requiring constancy of temperature.

2. Electrical standards and apparatus.

The department owns certified standards of resistance, electromotive force and inductances, and its cabinets contain apparatus of the best make for all electrical and magnetic testing. The Kelvin ampere balances, Weston standard and semi-portable voltmeters and ammeters, and Siemen's electrodynamometers of the department are frequently checked by the potentiometer with standardized resistances and Clark and Weston cells. The laboratory is supplied not only with apparatus but also with piers and conveniences for these tests.

3. Miscellaneous testing.

Besides the equipment for the work in the lines indicated above, the department of Physics is supplied for its instructional and research work with standard apparatus of a variety of kinds, all of which is available for testing purposes. Such facilities are standard barometers, standards of length, photometric standards with photometers, standards of weight with sensitive physical balances, a dividing engine and comparator, vacuum and compression pumps with gages, and various optical apparatus.

In the Railway Engineering Laboratory

1. A Railway Test Car for use on steam roads.

Since 1900 the Railway Engineering department has owned, jointly with the Illinois Central Railroad, a

dynamometer car designed and built especially for train resistance experiments and for tonnage rating tests.

This car is equipped with an oil transmission dynamometer and special recording apparatus, by means of which there are obtained curves of draw-bar pull, speed, time and other data. For facilitating the making of locomotive economy tests the car is also provided with apparatus which permits many of the observations, ordinarily obtained upon the engine, to be made within the car itself.

A new recording instrument is at present being installed, which is designed to draw automatically curves of pull, speed, acceleration, work, draw-bar horsepower, and wind velocity and direction; besides giving records of time, position and other information relating to locomotive operation.

Three railroads enter Urbana and Champaign,—the Illinois Central, the Wabash, and the Cleveland Cincinnati, Chicago and St. Louis Railways, the division shops of the last also being situated here. With these three railroads the department enjoys most cordial relations, and it can depend upon continuing to receive from them the same assistance and cooperation that have hitherto been extended. Opportunities for shop and road tests have been freely given and throughout the year numerous locomotive and train resistance tests are made both for instructional purposes and for the information of the railroads.

2. An Electric Test Car.

The Railway Engineering department owns also an electric test car which was designed especially for experimental work.

This car, of the interurban type, was built in 1905 and is provided with four 50 horse power 500 volt direct

current motors, operated by the Westinghouse multiple unit control. Within the car there is made autographically a record of current, voltage, speed, acceleration, curvature, time and position. By the courtesy of the Illinois Traction system the department is enabled to operate this car on their lines, which enter the University campus.

The Illinois Traction system connects the cities of Danville, Urbana, Champaign, Decatur, Bloomington, Springfield, and St. Louis, and operates at present about 250 miles of track. Part of this system is now being equipped with alternating currents. By the cooperation of the officials of this company the University obtains exceptional opportunities for experimental work in electric traction.

University Library

An account of the resources available for experimental work would be incomplete without mention of the very excellent facilities in the Library of the University, now containing 95,000 bound volumes and 17,000 pamphlets. It is a depository for the United States government publications, Library of Congress card catalog, John Crerar, (Chicago) library card catalog, and the British Museum catalog. It also subscribes to nearly 400 of the leading periodicals.

The library has complete sets of practically all of the leading scientific and engineering journals and proceedings of societies in English, French and German and by its system of exchanges with the Congressional, the Crerar and other leading libraries, even rare volumes can be obtained quickly.

Character of Work to be Undertaken

In determining the character of the work which the Station shall undertake, the most careful consideration will be given first to the needs and the interests of the state of Illinois. At the same time we shall not forget the debt which Illinois owes to her older sister states or to foreign nations for furnishing freely the results of scientific investigations or experimental determinations, making it possible for Illinois more cheaply to construct its railroads, mine its coal, generate its power, harvest its crops, communicate with its neighbors, and build its factories, its public buildings and homes.

The work of the Station will extend into some fresh fields, seeking to discover new ways and means for economizing energy and materials, for the prevention of waste, for the perfection of labor-saving machinery, for safer methods of travel, and for surer sanitary methods of water supply and sewage disposal.

Fuel supply is of such prime importance in our industrial development that no effort will be spared in the introduction and promulgation of improved methods and processes in the mining, preparation and consumption of coal. From broad economical considerations wasteful methods of using coal, or the rejection of any combustible part as waste, are to be discountenanced. Exhaustive and careful experiments will be required before the best conditions can be attained. These experiments must include analyses of coals from all parts of the state, a determination of the best kinds of coal for specific purposes, best methods of burning Illinois coals, effects of various methods of preparation, experiments on various kinds of furnace construction, etc.

Along the line of power production there is opportunity for much investigation. New problems are con-

fronting both the builders and users of steam and gas motors. There is at present a noteworthy change from the reciprocating engine of large size to the steam turbine. Gas engines of large power have recently been installed, and the development of this type of motor bids fair to be more rapid in the near future. Still newer types of motors are being proposed from time to time, the gas turbine being one that at present occupies much attention as an attractive possibility.

For the user of power, the Station can investigate questions relative to the economy of various types of power installations with given conditions of service. For the builder of motors it can investigate the new and perplexing problems that have arisen. The properties of the various fluids used in heat motors need careful study. Superheated steam is essential to the proper working of a steam turbine, yet many of its properties remain to be investigated. The properties of ammonia and other fluids used in refrigeration are not known accurately, and even the properties of saturated steam are based on Regnault's experiments made nearly seventy years ago. A careful investigation of the properties of heat media of all kinds, extending if necessary over a series of years, would furnish data of the greatest value to engineers, and would in addition be a noteworthy contribution to science.

Considerable work for the railroad interests has already been done by the Railway Mechanical Engineering department of the University. The dynamometer car owned jointly by this department and the Illinois Central Railroad has been used in numerous road tests, and these tests have been used as a basis for the computation of tonnage ratings. This work will be prosecuted vigorously under the direction of the new School of

Railway Engineering and Administration recently organized. Other problems relating to design, maintenance of way, electric traction, etc., will be attacked as they arise.

It is expected that the Experiment Station will prove helpful to the manufacturing and building interests. In the first place, it will supply accurate data regarding the properties of the materials used in engineering structures and buildings. The laboratory of applied mechanics with its extensive equipment furnishes ample facilities for this line of work, and the reinforced concrete tests now in progress show great possibilities. In the near future, an extensive series of tests on cast-iron columns, and on various forms of steel and iron members is contemplated. Secondly, the Experiment Station will investigate manufacturing processes. As an example of this line of work the high-speed steel tests are cited. Thirdly, problems relating to design and construction will be studied, and all useful results will be published for the benefit of those engaged in design or construction.

As a rule the Experiment Station will undertake only such investigations as will lead to results of fundamental importance, results that will be helpful to a large class of engineers or manufacturers. It will not, in general, undertake work of importance to individuals only, e. g., the testing of a device or invention for the sole benefit of the inventor.

PUBLICATIONS OF THE ENGINEERING EXPERIMENT STATION

Bulletin No. 1. Tests of Reinforced Concrete Beams, by Arthur N. Talbot. 1904.

Circular No. 1. High Speed Tool Steels, by L. P. Breckenridge. 1905.

Bulletin No. 2. Tests of High-Speed Tool Steels on Cast Iron, by L. P. Breckenridge and Henry B. Dirks. 1905.

Circular No. 2. Drainage of Earth Roads, by Ira O. Baker, 1906.

Bulletin No. 3. The Engineering Experiment Station of the University of Illinois, by L. P. Breckenridge. 1906.

Bulletin No. 4. Tests of Reinforced Concrete Beams, Series of 1905, by Arthur N. Talbot. 1906.

Bulletin No. 5. Resistance of Tubes to Collapse, by Albert P. Carman. 1906.

Bulletin No. 6. Holding Power of Railroad Spikes, by Roy I. Webber. 1906.

Bulletin No. 7. Fuel Tests with Illinois Coals, by L. P. Breckenridge, S. W. Parr and Henry B. Dirks. 1906.

Bulletin No. 8. Tests of Concrete: I. Shear; II. Bond, by Arthur N. Talbot. 1906.

Bulletin No. 9. An Extension of the Dewey Decimal System of Classification Applied to the Engineering Industries, by L. P. Breckenridge and G. A. Goodenough. 1906.

Bulletin No. 10. Tests of Plain and Reinforced Concrete Columns, Series of 1906, by Arthur N. Talbot. 1907.

Bulletin No. 11. The Effect of Scale on the Transmission of Heat through Locomotive Boiler Tubes, by Edward C. Schmidt and John M. Snodgrass. 1907.

Bulletin No. 12. Tests of Reinforced Concrete T-Beams, Series of 1906, by Arthur N. Talbot. 1907.

Bulletin No. 13. An Extension of the Dewey Decimal System of Classification Applied to Architecture and Building, by N. Clifford Ricker. 1907.

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